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Massachusetts Bay Transportation Authority

December 1983

Final Environmental and Socioeconomic Impact Report

The M.B.T.A. Fare Increase

Appendices

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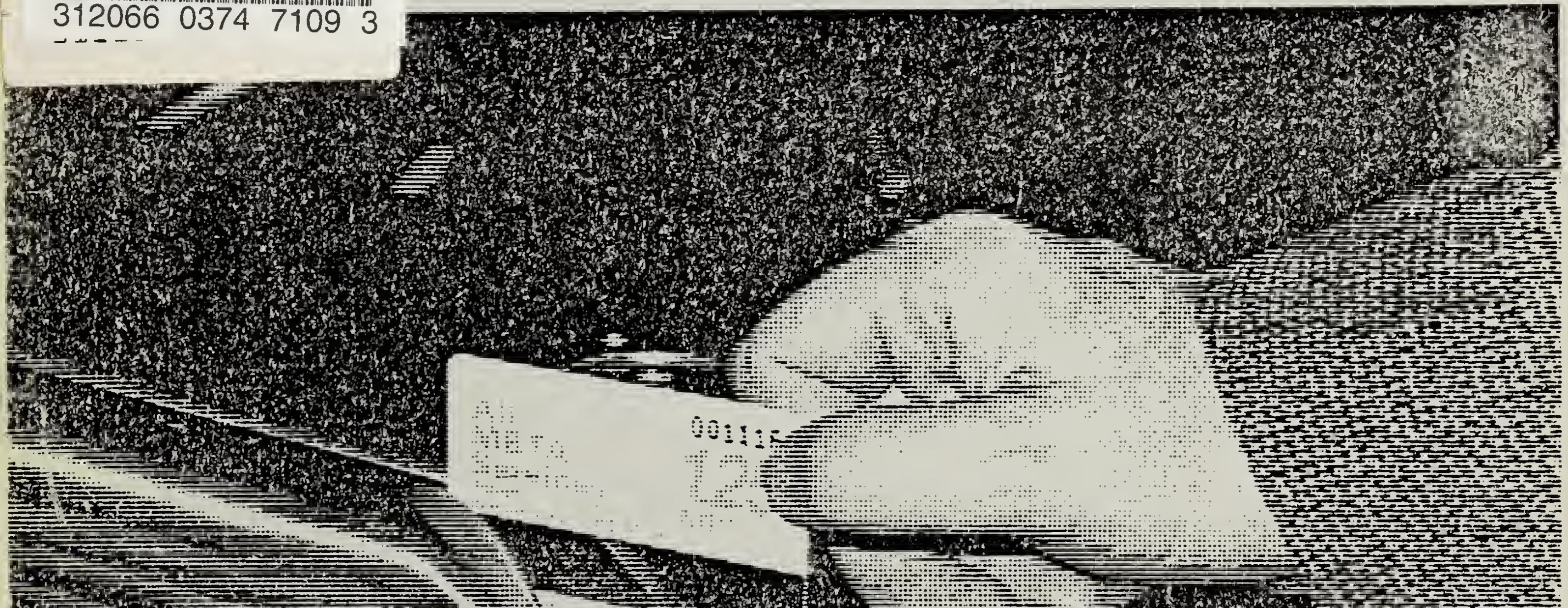

Prepared by the Central Transportation Planning Staff

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APPENDIX A-1

THE POLICY FRAMEWORK FOR THE MBTA AND THE REGION

I. M.B.T.A. GOALS AND POLICIES

The MBTA is a transportation operating agency. As such, its primary concern is to increase ridership while minimizing rises in costs. The following goals, stated in the 1977 Program for Mass Transportation of the MBTA, provide the MBTA management with both overall directional goals and some specific objectives which indicate the achievement of these goals.

MANAGEMENT GOALS:

- Increased Riders. To attract additional riders who can be served at reasonable cost in relation to present costs per rider.

- Control of Overall Financial Burden. To bring under control the overall costs of supplying public transportation and to seek an equitable distribution of the resultant financial burden among riders and public revenue sources.

- Improved Quality of Service. To improve the quality of service offered, where this is possible without unreasonable increases in costs per rider.

- Unit Costs and Productivity Improvement. To reduce the cost of supplying a desirable level of public transportation service and to increase the level of service provided at a given expenditure level.

- Improved Safety and Security. To reduce the hazards to which riders and employees are exposed in connection with public transportation service.

- Equitable Fares and Service. To implement a fare structure and fare level which are equitable in terms of price per value received and to apply uniform criteria for the establishment and discontinuation of service.

SOCIAL GOALS:

The MBTA is also an agency of government. Consequently, it must serve the public in an environment shaped by society's demands as expressed through its elected officials. It should be responsive to at least the following social goals:

- Provision for Riders with Special Needs. To provide transportation service for the elderly and handicapped persons, particularly those who do not have ready access to an automobile.

- Environmental Improvement and Fuel Consumption. To reduce air pollution, noise pollution, other forms of environmental degradation, and fuel consumption associated with supplying public transportation service.

- Equal Opportunity/Affirmative Action. To remedy the effects of any illegal discriminatory practices in the MBTA, to eliminate such practices, and to take positive action so that the MBTA work force reflects the racial and sexual composition of the population where the jobs exist.

- Economic Recovery. To contribute to the reduction of the unemployment rate in Massachusetts and stimulate the depressed economy through a large scale capital investment program.

- Land Use and Development. To contribute to and facilitate the process of land use planning and development for the long term.

Furthermore, the 1977 PMT directly discusses the costs which some goals may entail:

> "It is important to recognize that achievement of social goals may impose costs on the MBTA which are in excess of those associated with a strictly operating efficiency criterion. Investment of resources for social purposes produces returns, but not ones as easily identified as more riders or lower costs. Therefore, a dilemma facing the MBTA and the public will be how to share more equitably the burden of MBTA cost. Within the MBTA's control is the ability to achieve greater efficiency in both operations and construction, in order to stabilize the relationship between fare revenues and operating costs. Yet to be resolved is how the public will choose to share in the increasing costs of the MBTA as a means for achieving social goals."

Although the policies in the PMT are directed principally to quide the MBTA capital program, it states clearly that many of its specific objectives and policies under each of the overall management goals will be attained primarily through actions outside of the capital program. Below is a discussion of several of the areas of concern which are most relevant to the issue of fare increases, ridership, and revenue balancing:

1. Increased Riders

Public Transportation Service Policy. The most far reaching of the service goals stated in the MBTA's Service Policy for Surface Public Transportation, adopted by the Board of Directors on January 7, 1976, was:

> "To achieve an annual system passenger volume of 200 million riders by 1981 with approximately the same or fewer employees."

Although this specific goal has not yet been met, its statement implies that the MBTA should attract such an increase by providing better service and that it should be able to accommodate the increase when it materializes. At the same time, it must increase productivity by producing more service with the same number of employees.

2. Control of Overall Financial Responsibility

The MBTA is one of the highest cost operators of public transportation in the United States. In addition, fare revenues cover only about 30 percent of operating expenses, not counting debt service. If debt service is counted, the figure is closer to 25 percent. If the only major management goal were the reduction of losses, then a logical policy would be not only to stop building extensions of rapid transit service, but also to contract drastically existing service and to raise fare levels accordingly--with profound effects on the capital program. However, this is clearly not a viable policy, since there are other management goals, as well as public policy goals outside the context of MBTA management, that should be pursued, not the least of which is stimulating the regional and state economy.

MBTA management sees its responsibility rather as bringing under control the overall costs of supplying public transportation and seeking an equitable distribution of the financial burden among riders and tax sources. This will be accomplished by a variety of means.

A final policy relating to the goal of controlling and equitably distributing the financial burden is that of maximizing revenue obtainable from rentable or leasable property incidental to providing public transportation. With regard to the capital program, this means that MBTA will take advantage of opportunities for joint development in conjunction with new rapid transit stations or station modernization work. Where it is both profitable to the MBTA and convenient to passengers; where it does not impede transportation operations or passenger flow; where it is consistent with good design and land use practice; and where it is consistent with guidelines of the Federal government for use of grant funds, the MBTA will include space and/or other features in its design of stations or other facilities that can accommodate appropriate joint development.

3. Unit Costs and Productivity Improvement

Maintenance Policy. The MBTA recognizes that considerable improvement is needed in the general condition of its existing plant and vehicle fleet and in the cost of maintaining these in serviceable condition. This is not a problem that can be solved by setting idealized standards for this condition or by simply devoting more resources to the maintenance function. It is rather a problem of increasing the output for a given level of maintenance resources and of organizing the work so that this improvement actually takes place. The MBTA has the following objectives aimed at improving maintenance output:

- Train the work force and improve the quality of management toward maintaining existing equipment and the new equipment now on order in a systematic way.
- Develop better information systems to detect problems needing maintenance attention and to forecast workloads.
- Set reasonable goals for the gradual improvement of specific service conditions that depend on maintenance, such as number of cars available for service.
- Assure that major new investments do not in themselves lead to maintenance problems.
- Tighten up on spare vehicles in order to reduce the tendency to rely on spares as an alternative to preventive maintenance practices.
- Provide modern diagnostic and repair equipment.
- Provide modern facilities to house the maintenance operation.

4. Equitable Fares and Service

A fare system based on distance and quality of service is probably the most equitable in the long run for the MBTA region, particularly when additional rapid transit extensions are completed. It is also the most difficult to implement in a logistical sense and would require more sophisticated forms of fare collection equipment. Automatic fare collection equipment is now a part of the capital program, but should a decision be made to implement a significantly more complicated fare system, fare collection equipment adequate for that purpose would have to be included. Such a fare structure may also affect indirectly the capital program, since it could result in a shift of passengers from one mode of public transportation to another and, consequently, some shift in emphasis in capital investment.

The Authority has studied the ridership and revenue impacts of restructuring the fare system. Major readjustments of this system would call for increase of fares on some portions of the system.

The Surface Transportation Service Policy provides for an objective mechanism for making changes in public transportation service on the basis of riders, costs, and social factors. This would then indirectly affect the capital program in terms of any changes in the surface fleet requirements that could emerge from restructuring surface routes and service frequencies.

5. Environmental Improvement and Fuel Consumption

Air Pollution and Fuel Consumption Policy. It is not possible to make a general recommendation for the promotion of one transit mode over another on the basis of air quality considerations alone. This is because no transit mode has the lowest pollutants per vehicle mile in all categories of emissions. At the same time, transit modes are almost always superior to the private automobile. Therefore, a general policy of promoting mass transportation is beneficial with respect to air quality.

Pollution characteristics of the public transportation modes are closely related to energy consumption. An improvement in energy efficiency will generally lead to less pollution. The levels of energy consumption for transit submodes at the MBTA differ greatly from typical levels for transit in the United States. This is particularly true for rapid transit, where the data seem to indicate that the present power generation and delivery system is grossly inefficient in terms of fuel per car mile, in relation to a typical rapid transit operation.

It is the MBTA's policy to reduce the pollution generation characteristics of its system by renewal and replacement of its existing power distribution system and of its buses, trolleys, and diesel rail engines. It is the MBTA's policy to improve pollution abatement at its existing power source, to reduce energy consumption and pollution levels by switching to a more efficient, privately supplied source of electric power, and by reducing as much as possible pollution/energy intensive practices, such as running bus engines overnight. Federal requirements for planning certification and for capital assistance also provide assurance that air quality is considered in MBTA planning and management.

Noise Policy. The MBTA takes all reasonable design measures to reduce noise effects, particularly in areas adjacent to residential areas in areas of high employment density. All reasonable measures are taken to design vehicles and stations to reduce noise effects.

II. RELEVANT POLICIES OF THE BOSTON REGIONAL TRANSPORTATION SYSTEM

The MBTA is an integral part of the regional transportation system and, as such, it shares the transportation-related goals and objectives of the region. These goals and objectives are agreed upon by the agencies which compose the Metropolitan Planning Organization and are supported by a policy framework.

The bulk of policies expressed in the Regional Transportation Policy Framework is oriented towards the capital improvement program. These are not included here. Rather, the following is an edited version which includes only the portions relevant to the MBTA and its Service and Fare Policy. The entire regional policy may be found in the current Transportation Plan for the Boston Region.

The preeminent stated goal of the transportation planning program for the Boston region is to improve the region's transportation facilities and services in a manner which enhances the quality of life for the people who live, work, and travel here--now and in the future.

1. Costs in Operating the Transportation System

The policy for cost control focuses on the reduction of costs and the implementation of projects, which reduce operating requirements. In part, the policy states:

> "Through increasing the productivity of the public transportation system operations and improving construction and maintenance techniques for the transportation system as a whole, the costs of operating the system can be controlled."

REGIONAL GOAL ON COST:

Make optimum use of existing facilities and, thus, wherever possible, incur a minimum of capital outlays.

REGIONAL OBJECTIVES ON COST:

A. Undertake careful analysis of all projects, including low-cost alternatives.

B. Emphasize projects which increase the use and capacity of existing facilities.

C. Improve the efficiency of the existing transportation system, so that maximum benefits are derived at reasonable cost to the public.

2. Equity and Accessibility

The transportation system must serve all of the people of the region, without systematic bias based on geographic location, income, race, or physical disability. In particular, special efforts are necessary to ensure that the system addresses the needs of the elderly and handicapped. The system must strive to provide a real choice of transportation modes to all segments of society.

GOAL:

Transportation systems should be designed to equitably service and reinforce the social and economic vitality of the region's communities. In addition, special emphasis should be placed on meeting the transportation requirements of those with special needs (e.g., the elderly, the disabled, economically deprived, etc.).

OBJECTIVES:

A. Increase Accessibility to Populations with Special Needs. An objective of the transportation plan is to make the transit system more accessible to persons with physical disabilities, where economically and technologically possible; otherwise, to provide for specially-designed service.

B. Increase Sensitivity to Needs of Minorities and Low-Income Groups. Future design and planning of facilities should be particularly sensitive to the special needs of minority and low-income groups. These people are particularly affected by the high cost of travel by private automobile, which severely inhibits their participation in the job market and other economic spheres.

3. Energy

The transportation program needs to ensure that conservation and the efficient utilization of energy resources occur in both the operation of facilities and the development of new infrastructure.

Because fossil fuels are becoming a scarce and, therefore, costly resource, the plan should emphasize actions that decrease fuel consumption per trip (for example, by increasing auto-occupancy rates and by increasing transit usage and the number of passengers per transit vehicle). Ideally, a reduction in fuel consumption will not affect the total number of trips in the region.

GOAL:

To coordinate and encourage an energy-conserving transportation syste, which offers modal choice while maintaining efficiency.

REGIONAL OBJECTIVES ON ENERGY:

A. Support improvements in transportation that conserve energy.

B. Continue to develop transit as an energy-efficient form of transportation.

C. Emphasize strategies and actions that decrease fuel consumption per trip.

D. Encourage fuel conservation by transit vehicles and fixed facilities through revised design and maintenance.

4. Environmental Quality

Transportation facilities must be compatible with the environment of the region. In addition, the transportation plan must include measures to reduce air, noise, and water pollution.

GOAL:

To attain and maintain the highest possible level of environmental quality for the region.

REGIONAL OBJECTIVES ON ENVIRONMENTAL QUALITY:

A. Reduce Vehicle Miles of Travel (VMT). Program elements should be developed to reduce VMT regionwide by drawing automobile users to the transit system. Reduction in VMT will lead to air quality improvements, reduced land requirements of highways and parking facilities, and other environmental benefits.

B. Improve Areas Along Transit Routes. Areas near transit routes can be greatly improved by the elimination of elevated structures in developed residential areas, reducing street congestion caused by transit vehicles, and by minimizing negative local impacts of new transit construction.

In conclusion, the basic policy framework for transportation planning in the region is to seek an improved transportation system that is environmentally compatible, socially equitable, energy conscious, cost efficient, and related to regional land use and economic development goals.

APPENDIX A-2

THE MBTA BUDGET* 1978-1982 AND AN EXPLANATION OF NET COST OF SERVICE

The Authority monitors its daily financial activities by accumulating costs within the line items. The line items shown on the statement of Net Cost of Service, 1978-1982 represent the sum of the Authority's expenditures. For control purposes, these same line items can be tracked to each of the Authority's organizational units.

1. Revenue from Transportation

   This is the income derived from MBTA rapid transit, streetcar, and bus operations. 1982 Revenue from Transportation has decreased to an annualized rate of approximately $88 million, caused by the reduction of fares in the spring of 1982. Revenue from Transportation is projected to increase (by approximately 4.5%) in 1983 due to a projected increase in ridership.

2. Revenue from Other Railway Operations

   This line represents income derived from the rental of fixed assets owned by the Authority and from advertising on Authority property.

3. Non-Operating Income

   This is income which results from the investment of cash and Bond Issue proceeds. This income will decrease in the future because the State has altered its method of advancing cash to the MBTA, now advancing smaller amounts over shorter periods of time. In addition, in an effort to soften the impact of the fixed charges on the Authority's budget, the Bond Issues needed to support the cash needs of the MBTA's construction programs are also planned to be made in smaller amounts for shorter periods of time.

4. Gasoline and Diesel Tax Reimbursable

   This line represents reimbursement by the State to the MBTA of the State gas and diesel taxes which the Authority must pay to vendors for its fuel purchases.

5. Reimbursement from Outside Districts

   This is the reimbursement made to the Authority by those localities which receive commuter rail service, and which are

---

*Not including Capital Expenditures Budget.

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
NET COST OF SERVICE

	1978 Actual	1979 Actual	1980 Actual	1981 Actual	1982 Projected	1st 6 Months 1983	Calendar 1983	Fiscal 1984
Income:								
1 Revenue from Transportation	$ 55,196,145	$ 56,727,494	$ 66,197,081	$ 81,811,655	$ 91,251,611	$ 46,070,000	$ 92,140,000	$ 93,952,800
2 Revenue from Other Railway Operations	2,103,421	2,263,665	2,650,449	3,101,327	3,300,001	1,788,217	3,576,434	4,094,534
3 Non-Operating Income	8,099,828	13,650,718	13,622,874	17,227,923	9,129,487	3,397,000	5,723,000	5,349,000
4 Gas & Diesel Tax Reimbursable	409,183	431,431	478,847	517,631	541,200	270,000	541,200	541,200
5 Reimbursement from Outside District	1,861,462	1,968,721	3,385,982	1,509,560	1,300,000	600,000	1,200,000	1,200,000
TOTAL INCOME	67,670,039	75,042,029	86,335,233	104,168,096	105,522,299	52,125,217	103,180,634	105,137,534
Operating Wages and Fringe Benefits:								
6 Wages	121,425,859	129,721,199	140,574,029	137,873,214	134,569,175	67,081,767	133,347,403	132,765,451
7 Gen. & Adm. Cost Capitalized-Credit	-	-	-	(2,060,840)	(2,007,7831	(776,785)	(1,553,570)	(1,553,5701
8 M.B.T.A. Pensions	16,725,658	18,830,410	21,349,749	20,285,101	18,968,153	9,876,450	19,633,631	19,402,444
9 Social Security Taxes	6,712,769	8,409,994	9,592,495	10,383,167	10,267,695	5,129,307	10,297,606	10,258,615
10 Workmen's Compensation	1,812,198	2,812,368	3,441,116	3,281,399	3,752,876	2,814,192	3,752,876	3,752,876
11 Accident and Sickness Insurance	407,533	431,677	438,416	427,971	364,162	180,816	361,632	361,632
12 Group Life Insurance	688,547	670,677	694,013	909,421	888,405	454,788	909,576	909,576
13 Blue Cross - Blue Shield	12,685,570	13,590,031	14,403,366	16,403,968	17,374,473	9,924,684	19,849,368	21,654,577
14 Unemployment Insurance	52,350	267,363	178,800	786,430	400,000	200,000	400,000	400,000
15 Uniform and Work Clothes	414,089	541,660	587,473	532,615	532,524	350,375	627,773	627,773
16 Fringe Benefits Cost Capitalized - Credit	(3,408,571)	(5,753,1211	(7,588,8941	(7,482,2131	(7,499,7461	(3,755,1351	(7,510,2701	(7,510,2701
TOTAL OPERATING WAGES & FRINGE BENEFITS	157,516,002	169,522,258	183,670,563	181,340,233	177,609,934	91,480,459	180,116,025	181,069,104
17 Material and Other Items	21,622,746	24,755,273	30,783,586	30,992,979	33,007,830	19,439,086	37,957,063	41,027,074
18 Injuries and Damages	2,099,955	2,517,339	2,666,762	2,940,880	2,884,881	1,692,440	3,384,880	3,384,880
19 Unreimbursed Cost of Service	-	(2,800,0001	2,800,000	-	-	-	-	-
20 Interest on Unfunded Debt	7,280,540	11,795,984	16,553,721	22,868,808	21,611,565	9,506,250	19,012,500	19,012,500
21 Fuel	12,261,738	16,208,764	22,265,512	23,239,837	22,343,472	11,600,619	23,341,339	23,635,439
22 Taxes (Other than Included above)	792,861	864,974	881,531	1,008,541	990,852	495,411	990,822	990,822
23 Railroad Commuter Subsidy	31,033,826	37,997,194	44,870,592	47,096,950	46,196,373	22,998,186	45,996,373	45,996,373
24 Local Service Subsidies	895,317	1,112,288	1,517,912	1,511,20C	1,613,184	1,100,414	2,074,721	2,074,721
TOTAL OPERATING EXPENSES AND TAXES	233,502,985	261,974,074	306,010,179	310,999,428	306,258,091	158,312,865	312,873,723	317,190,913
Fixed Charges:								
25 Interest on Funded Debt (M.T.A.)	3,774,469	3,686,265	3,423,192	3,637,624	4,144,824	2,704,484	5,408,968	5,408,968
26 Interest on Funded Debt (M.B.T.A.)	16,904,784	19,235,046	20,047,186	20,891,292	31,456,901	20,413,739	44,525,895	46,924,313
27 Payment on Funded Debt (M.T.A.1	2,999,259	2,824,259	2,723,259	2,537,259	2,631,926	1,801,352	3,602,704	3,602,704
28 Payment on Funded Debt (M.B.T.A.)	9,326,748	9,331,173	10,710,000	10,685,000	12,829,250	8,507,500	17,015,000	19,995,000
29 Bond Discount Amortization (M.B.T.A.)	-	-	-	21,150	84,600	-	-	-
30 Miscellaneous Debits (M.T.A.)	46,879	35,838	56,000	45,989	-	-	-	-
31 Bank Service Charges (M.B.T.A.)	35,112	49,752	24,000	23,870	101,500	75,000	150,000	150,000
TOTAL FIXED CHARGES	33,087,251	35,162,333	36,983,637	37,842,184	51,249,001	33,502,075	70,702,567	76,080,985
TOTAL CURRENT EXPENSES	266,590,236	297,136,407	342,993,816	348,841,612	357,507,092	191,814,940	383,576,290	393,271,898
COST OF SERVICE IN EXCESS OF INCOME	198,920,197	222,094,378	256,658,583	244,673,516	251,984,793	139,689,723	280,395,656	288,134,364
32 State Fin. Contract Assist. - M.T.A.	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	1,500,000	3,000,000	3,000,000
33 State Fin. Contract Assist. - M.B.T.A.	21,696,562	23,840,018	26,524,496	29,906,496	39,161,667	27,914,214	59,170,414	62,291,836
34 Federal Operating Assistance	26,628,398	27,422,397	29,328,419	26,236,287	20,281,265	10,140,633	20,281,265	20,281,265
35 NET COST OF SERVICE — LOSS	$147,595,237	$167,831,963	$197,805,668	$185,530,733	$189,541,861	$100,134,876	$197,943,977	$202,561,263

Table
A-1

M.B.T.A. Net Cost of Service - 1978-1981, Projected 1982-1984 outside the 79 cities and towns which form the MBTA district. The reimbursement is provided to the outside districts by the federal government. There is substantial uncertainty concerning the future of these subsidies due to differences between the reductions proposed by federal Executive and Legislative branches.

6. Wages

This line contains the salaries of all individuals working on daily operations of the MBTA. Separate from this line and with its own budget (not included within this document) is the Construction Directorate of the MBTA. This Directorate is funded by a split of approximately 80% federal support and 20% Authority bonding.

As can be seen from the Net Cost of Service statement, wages for the Authority peaked in 1980. In 1981, the Authority dropped over 600 individuals from its payroll and over the next two years, will drop an additional 100 individuals from the 1981 level.

The transit industry, unlike other businesses, has peaks during mornings and evenings of each day, which mandated an available work day for many workers of 11 plus hours although they physically had to be on the property for only eight plus hours. The amount of time that operators were required to be available, but were not actually working, was paid at a "spread time" rate (10th to 11th at ½ salary, 11th plus hours at regular pay).

In analyzing the wage line from the Net Cost of Service, it should be noted that the Authority, in 1981, began to show the dollars charged by operating personnel to capital construction on a separate line, "General & Administration Cost Capitalized-Credit." Prior to 1981, these dollars were directly deducted from the wage line. Therefore, the Authority, in 1981, reduced its wage line not by $2,700,815 but by $4,761,655.

7. General and Administrative Cost Capitalized - Credit

This line is an accounting adjustment. It credits operating expenses for indirect overhead charges and material handling expenses which can be charged to the Construction Directorate. The percentage basis for the credit is approved and audited by the Urban Mass Transportation Administration, which is contributing approximately 80% of the cost of the Construction Directorate.

8. MBTA Pensions

This line is calculated based on an Authority contribution to the employee pension fund of 12.1875% of wages. In addition to the Authority contribution, employees contribute 8.0625% of their salaries. The pension play is based upon a normal retirement age of 65 (the mandatory retirement age has been increased to 70). An early retirement is available, regardless of age, based upon 23 years of creditable service. An early reduced retirement is available based on 20 years of creditable service at age 55, but the computed retirement allowance is reduced by one-half percent for each month the member is under 65. The plan also provides for occupational and non-occupational disability retirement after four years and eight years of creditable service, respectively.

9. Social Security Taxes

All employees at the Authority are covered by social security. The present employer contribution is 6.7% of salary for the first $32,400.

10. Workmen's Compensation

The MBTA, as an employer in the Commonwealth, is required to provide Workmen's Compensation coverage pursuant to Chapter 152 of the Massachusetts General Laws. The Authority, in accordance with Section 25A of Chapter 152, has elected to be a self-insurer for the purpose of providing compensation to employees injured or disabled in the course of their employment. As a self-insurer, the Authority must furnish the Treasurer of the Commonwealth with a bond sufficient to meet the insurer's liability. In addition to this bond, the Authority must establish a re-insurance program to fund liabilities for catastrophic loss.

11. Accident and Sickness Insurance

The Authority provides its employees with $2,500 accidental death and dismemberment coverage and 26 weeks of coverage for accident and sickness. The death and dismemberment policy costs $.20 per employee per month and the health and accident $5.31 per employee per month.

12. Group Life Insurance

The Authority provides $9,000 of life insurance coverage to weekly employees at a cost of approximately $10,80 per employee per month, which is reduced to $2,000 of coverage at approximately $2.40 per month at retirement. New weekly employees have a one-year waiting period for coverage. Monthly and executive employees receive $9,000 paid life insurance at approximately $10.80 per month, and may choose to take up to one and one-half times their salary in additional life insurance coverage. The Authority will pay half of the premium above the $9,000 basic coverage. At retirement, the basic coverage is reduced to $2,000 paid 100% by the Authority. Anything over that is shared on a 50% basis up to one-half the amount of the before-retirement salary.

13. Blue Cross/Blue Shield

The Authority provides paid medical coverage to all its employees under age 65 (retired individuals under age 65 who retired after January 1, 1954 are also covered). On January 1, 1982, the Authority switched from a premium basis to a cost basis for all current employees (except for dental coverage which remains on premium and is shared 50% by employees). The savings during 1982 resulting from the changeover was approximately $3.5 million. Even with savings realized because of the change to cost basis payments, the Authority will still have to meet the increases which are occurring in the medical field.

14. Unemployment Insurance

During 1982, two different groups of layoffs caused a rise in Authority Unemployment payments:

a. In approving the 1981 budget, the Advisory Board imposed financial ceilings on the Authority causing operations cutbacks that necessitated the layoffs of large numbers of employees.

b. The Authority laid off 68 rapid transit train guards which, while reducing wage costs by $2 million increased unemployment contributions.

15. Uniforms and Work Clothes

This line contains the dollars for two types of clothing:

- Uniforms. Operational personnel, coming in contact with the general public, are provided "T" uniforms. Transportation worker uniforms are priced at $314 for initial issues and Police at $500 for initial issues.

- Work Clothes and Safety Apparel. The Authority, by union contract and to meet the requirements of the Occupational Safety & Health Administration, provides its shop workers with work clothes and safety apparel. Work clothes are budgeted at approximately $84 per worker per year, and safety items such as gloves, acid clothing and eye protection are priced in groupings by historical usage.

16. Fringe Benefits Cost Capitalized - Credit

This line is an accounting adjustment which credits operating expenses for pension, vacation, holiday, sick pay, insurance and other benefits which are incurred by individuals charging work effort to the Construction Directorate.

17. Material and Other Items

This line item contains the costs for the following:

- Materials. The Authority is responsible for maintaining a large variety of vehicles and equipment, rail lines and buildings. Past experience has provided data that enables the Authority to calculate, based on transportation schedules, how much repair work of what type will be required in the course of a year. For example, 450 bus transmissions are rebuilt per year; 145 bus motors are rebuilt per year; 31,600 feet of rail are replaced; 5,000 rail ties are projected for replacement. The Authority in 1983/FY84 has level funded its Material request except for parts on buses which are no longer on warranty, repair of bodies on Green Line cars, replacement of batteries on Red Line cars, and parts for Orange Line cars which are no longer on warranty. The Authority is planning on absorbing any inflationary increases through better inventory control, more efficient planning of parts utilization and less use of original equipment manufacturers' parts.

- Services. The Authority has contracts for parts rebuilding, station cleaning, bus cleaning, escalator repair, watchman services and various other functions which it has determined can be more efficiently or effectively accomplished by outside sources.

- Rent. The Authority lease at 50 High Street, Boston, for approximately 46,000 sq. ft. of administrative space expired July 1982. Current proposals from Meredith and Grew (the landlord) establish the new cost for a tenancy at will at approximately $13 per sq. foot for the majority of its space, or approximately 144 percent of the prior lease.

- Utilities. This line contains the cost of telephone service; gas, steam, oil and electricity for heating, lighting, and power; and water and sewer services.

18. Injuries and Damages

The Authority has approximately 8,000 outstanding claims and court suits against it for injuries and damages. During an average year, approximately 5,200 claims are processed and settled and the balance is carried forward. (In addition to the $1 million and rail injuries up to $2.1 million per accident or occurrence.)

19. Unreimbursed Cost of Service

This line represents commuter rail costs which were deferred from one year to the next (1979 to 1980) pending Advisory Board approval of the expense.

20. Interest on Unfunded Debt

The Authority, as does any company, requires working cash to meet its daily operating expenses. This line contains the interest charges on $195 million in outstanding notes which are renewed on a yearly basis and which partially meet the cash needs of the Authority.

21. Fuel

Two basic components are contained within this line.

- Power for running the system.
- Fuel for buses and other equipment.

	1982 Price
Diesel Fuel:	$.95 to $1.07 per gallon
Unleaded Gas:	$.95 to $1.13 per gallon
Regular Gas:	$.91 to $1.09 per gallon

22. Taxes

This line accounts for the fuel tax payments made by the Authority to the Commonwealth, those payments being based upon both volume and price per gallon. Also covered within this line are license fees for operators, and tolls on the Mass. Turnpike, tunnels and the Tobin Bridge.

23. Railroad Commuter Subsidy

This line contains the contract for the Boston and Maine Railroad to operate the commuter rail services for the MBTA. Commuter Rail ridership increased over 9% in 1982 and the Authority is projecting this trend to continue.

24. Local Service Subsidy

This line is comprised of two elements.

a. THE RIDE. This program is the MBTA's specialized paratransit service for handicapped persons. It exists in response both to a need expressed by the handicapped community and to certain federal regulations, principal among these being Section 504 of the Rehabilitation Act of 1973, as amended. Subsequent to the initial requirements provided by the regulation, the Authority has made efforts beyong those required by statute.

b. Subsidies to Local Bus Services. The primary motivation of the Authority in subsidizing bus services is to maximize service levels for the lowest cost. The Authority is currently involved in two such relationships. In both instances, the Authority underwrites the net loss of services.

In both cases subsidized by the Authority, a private carrier provided fixed route local services at a loss and appealed to the Authority for financial assistance.

Rapid Transit, Inc. has provided service in Winthrop feeding Orient Heights Station as well as meeting local transportation needs since 1942. In 1968, the Authority entered into a relationship which has continued uninterrupted. In 1981, this system provided 1.2 million rides for a net cost of $450,000.

Michaud Bus Lines, as the local carrier in Salem and Peabody, has provided local service since 1954. In May of 1977, the company gave notice they could no longer continue to incur an operating loss on the so-called "Salem-Peabody Loop." In January of 1978, the Authority began a subsidy arrangement with Michaud Bus Lines which continues today. In 1981, this system provided 150,000 rides for a net cost of $85,000.

25. Interest on Funded Debt (MTA)

This line reflects the interest charges on Boston Metropolitan District (BMD) Bonds which are currently outstanding, as well as those BMD Bonds which have matured and are planned to be refinanced in December, 1982.

BMD Bonds are those bonds issued prior to 1964 to support the Boston Metropolitan District, which was one of the transit systems which formed the MBTA. Upon its formation in 1964, the MBTA was made responsible for the debts of its transit systems. There is approximately $87,132,000 in outstanding BMD debt.

26. Interest of Funded Debt (MBTA)

This line represents interest payments on bonds which are issued to support approximately 20 percent of the Authority's Capital Construction Program (the other 80 percent is federally funded).

27. Payment on Funded Debt (MTA)

    This line reflects the principal payments for the BMD Bond Issues described in #25 above.

28. Payment of Funded Debt (MBTA)

    This line represents the principal payments for the Bond Issues described in #26 above. Part of the increase in these payments is due to a reduction in maturity from 40 years for the original issues to 20-25 years for current issues (in the current Bond market there is no demand for Bonds with greater than 20-25 years maturity). The remainder of the increase is due to the increased capital needs of the Authority's construction program.

29. Bond Discount Amortization (MBTA)

    In 1981, this amortization charge represented the difference between the principal repayment and the amount actually received after discount for Bond Issues. The initial method of handling a discount Bond was to list the payment and amortization as separate charges. Subsequently, for budget purposes, amortization has not been included as a separate line item because it is an accounting function whereas repayment is a cash requirement.

30. Miscellaneous Debits (MBTA)

    This line represents the fiscal agent's charges for paying the BMD Bond coupons, as well as paying the Bonds themselves as they mature.

31. Bank Service Charges (MBTA)

    These charges represent the fiscal agent's charges for paying the Authority's Construction Bond coupons, as well as the principal on these Bonds as they mature.

32. State Financial Contract Assistance (MTA)

    This line represents the State's contribution to the Authority's payment of the BMD debt. The State has limited this payment to a maximum okf $3 million per calendar year for the principal and interest charges on the BMD Bonds (see #25 above).

33. State Financial Contract Assistance (MBTA)

    This line represents the State's contributions of 90 percent of the principal and interest payments of the Authority's MBTA Bonds (see #26 above).

34. Federal Operating Assistance

This line represents funds which are provided by the federal Urban Mass Transportation Administration (UMTA) to support the general operation, as opposed to the construction efforts of the MBTA. These funds help reduce the operating deficit of the Authority and therefore, help reduce the financial impact on the State, as well as on the cities and towns in the MBTA district.

35. Net Cost of Service - Loss

This line is the net deficit after the application of the various assistance provided to offset the MBTA's operating deficit. That assistance is described in #'s 32-34 above. The net deficit amount is shared by the State and the cities and towns in the MBTA district. The portion paid by the cities and towns was capped at $95 million for calendar year 1981.

APPENDIX A-3

SCOPE FOR MBTA FARE STUDY: ENVIRONMENTAL IMPACT REPORT AND SOCIOECONOMIC IMPACT REPORT

Following are the proposed work scope outlines of the Environmental Impact Report (EIR) and the Socioeconomic Impact Report (SEIR) for the MBTA Systemwide Fare Increase, dated October 30, 1981.

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

EDWARD J. KING
GOVERNOR
JOHN A. BEWICK
SECRETARY

PROJECT NAME:	System Wide Fare Increase
PROJECT LOCATION:	Statewide
EOEA NUMBER:	4147
PROJECT PROPONENT:	MBTA
DATE NOTICED IN MONITOR:	July 7, 1981

SCOPE FOR GENERIC EIR

This scope and alternative for the MBTA System-wide Fare Increase (EOEA 04147) supplements the outline scope provided in the Certificate of the Secretary, dated July 31, 1981.

I. Base Case and 1980, 1981 Increases

1. Description of existing system.

This section should succinctly summarize the main components of the MBTA system, sufficient to acquaint the public reviewer (who may only be familiar with discrete components of the system) with its broad outlines and inter-relationships. Rapid transit rolling stock, commuter rail operations, railbed, buses, routes, yards and garages, commuter parking lots, extensions under construction, and key intermodal transfer points should be identified and located on maps with enough clarity to convey an overall understanding of the outlines of the system.

2. Brief summary of funding sources and breakdown, and of budgetary process (describe distribution of increase in farebox revenues).

3. Review of past fare structures and levels, and describe 1980 and 1981 fare increases. Plot fares against fuel cost, overall inflation. Show (charts

or graphs) 1970-1981 budget levels, ridership levels, and percentage paid by different funding sources.

Compare average T-fares to cost of living index; compare to other cities (cost) cost/mile - if possible include 1960, 1970 and current figures.) Compare with automobile operating costs.

4. Describe service cuts and restorations, 1979 to date.

5. Analytic methods.

   a. Describe data available to the T to determine actual ridership (including different modes, and different categories of riders).

   b. Describe alternate ways of calculating or estimating ridership (modes, categories).

   c. Describe efforts under way to improve data base, and any future changes considered.

6. Ridership, 1950-1980

   a. Provide historical ridership figures, broken down at least into rapid transit, rail, express and local bus. Provide ridership percentage in geographic parts of system (e.g., (i) downtown core (peak, off-peak), (ii) crosstown, core to 6 mile radius (peak, off-peak), 6 mile radius to 128, outside 128). Where needed for SIR* input, disaggregate by line or route. Discuss transit load factors (peak hour and daily); number of riders per rapid transit car, railcar and bus.

7. Operating trends.

   a. Comparison of peak hour quality of service (average speeds. passengers moved per hour) with off-peak performance, and with theoretical operating capacity of a system operating efficiently and according to safety requirements.

   b. Trend in revenue/operating costs ratio; costs/passenger; cost/mile

   c. Trend in capital costs per passenger mile (rapid transit, bus)

   d. Calculated energy efficiency trends: revenue car-miles per unit of input energy; rail and bus passenger-MPG.

8. Summarize status and recommendations of other public/private studies, task forces, committees to improve the MBTA (1970-1981).

II. Prediction and Measurement of Ridership Losses Due to 1980,1981 Fare Increases

1. Discuss trip elasticities.

Describe methods of analysis. (If both arc elasticities and simple elasticities are used in the EIR, avoid commingling them.)

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* Socioeconomic Impact Report

2. a) Predicted and (b) measured effects on ridership of 1980 fare increase (show calculations; break down into ridership profile. Review displacement from Rapid Transit to bus.)

3. a) Predicted and (b) measured effects on ridership of 1981 fare increase (show calculations; break down into ridership profile).

4. Past and recent data on effects of fare increases in other cities. (identify length of average ride, transfer characteristics; describe response of total revenues to fare changes.)

5. Discuss effects on ridership of level and quality of service on peak and off-peak ridership. How is this weighed in ridership loss projections?

6. Discuss effects on ridership of availability of alternate transportation. Does it play a significant enough role to warrant incorporation into ridership loss projections?

7. Assess and articulate the role of elasticity and analysis in operations planning. How useful is it? What are its limitations, and how can these be avoided?

III. Environmental Impacts of Ridership Losses

1. Data preparation: transform estimates of ridership loss into estimates of increased vehicle miles travelled (VMT). Discuss methodology.

2. Apportion estimated VMT increases to main corridors into, out of city; where possible, apportion onto routes within city. This part of the study should utilize Turnpike bridge and Tunnel toll information, MDPW traffic counts, and data on parking lot use. In addition a special effort should be made to verify calculated increases, by random checks with individuals having first-hand experience (toll-takers, police, TV helicopter newsmen, auto commuters).

3. Increased Traffic Congestion: Estimate congestion increases for I-93, Expressway, Mass. Pike, Storrow Drive. Discuss congestion increases at selected intersections for which detailed intersection data are available (e.g., Blue Hill Avenue and American Legion Highway, Commonwealth Avenue at the B.U. Bridge, Cambridge and Staniford Streets, Science Park). Assess potential for indirect impacts of increases traffic on local streets.

4. Discuss sketch planning techniques for assessing air pollution impacts of increases VMT and increased congestion.

5. Assess air pollution impacts of ridership losses (1980 and 1981, aggregrated), by reference to a) areawide increases, and b) selected intersections identified as CO hot spots. Discuss compatibility with SIP.

6. Energy: Assess change in energy usage resulting from 1980 and 1981 ridership losses (both fare increases and service cuts).

IV. Alternatives

The EIR should formulate a series of alternative fare structures, both those limited to existing funding and those which would be dependent on additional funding. I suggest that the following would warrant examination:

1. No action or prior fare and service structure (July 1981) with budget shortfall, and what it means for service quality and continuity.

2. Fare increase as implemented on August 1, 1981 and effective for November 1981, including partial restoration of service cuts.

3. Modified fare structure.

   a. Free or reduced transit fare for certain groups

   b. Peak period pricing, including past experience with Dime Time and implications of current off-peak free elderly travel

   c. Lower rates for transfers

   d. Lower fares for downtown distribution (refer to practice in other cities).

   e. Pre-paid or self-service bus fare system (analyze potential reduction in travel time and resultant increase in service)

   f. Timed transfer points, route consolidation, posting schedules at stops.

Discussion of the above options should include a description, statement of goals and potential advantages; discussion of feasibility and operational problems; discussion of un-wanted side-effects and potential avoidance mechanisms, ability to stimulate ridership, and effect on revenues.

V. Mitigating Measures for Fare Increases, Service Reductions, Increased Auto Use

A. Operational Changes (discuss feasibility, programs in effect, programs under consideration.) Procedures for route evaluation should be described. Analysis of specific routes is outside the scope of the EIR, although it may be a necessary part of the SIR where especially severe impacts are identified.

   1. Service restoration

   2. Service quality improvements, with the goals of more frequent and reliable service, less crowding and higher travel speeds.
   current implementation status of 1977 MBTA Service Policy

   3. Describe current or proposed productivity measurement programs:

Service Policy for Surface Public Transportation
Rail Service Standards
Service Evaluation Project (SENTRY)
MBTA Systemwide Passenger Data Collection

Identify performance criteria, methods of monitoring results. This information plus means of monitoring individual or group achievement, will be an important component of the Management Practices Study, but descriptions of the programs should be assembled and included in the EIR, due to the importance of such evaluation in mitigating impacts.

4. Other

B. Changes requiring legislative action: provide conceptual discussion of proposal disadvantages (including cost effects), history of previous attempts, if any; discuss whether action will be sought.

1. Human Service user-side subsidies of special needs, lower income.

2. Cost-of-living price indexing

3. Sales tax, gas tax funding

4. Other

VI. MBTA Expectations for Short-Term and Long-Term Service and Fare Stability Over the Next Decade.

Discussion of planning and operating goals and methods to achieve fiscal stability for the MBTA.

October 30, 1979
DATE

JOHN A. BEWICK, SECRETARY

JAB:SGM:cg

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

EDWARD J. KING
GOVERNOR
JOHN A. BEWICK
SECRETARY

PROJECT NAME:	System Wide Fare Increase
PROJECT LOCATION:	Statewide
EOEA NUMBER:	4147
PROJECT PROPONENT:	MBTA
DATE NOTICED IN MONITOR:	July 7, 1981

SCOPE OF SOCIOECONOMIC IMPACT REPORT (SIR)

I. Introduction: Articulation by MBTA of socioeconomic values of public transportation

  A. Values to users: access to place of employment, to education, to health services, to recreation/socialization, to necessities

  B. Values to business/commerce: access by customers, employees

  C. Values to neighborhoods, political units: ecomomic health, tax base, growth/vitality

II. Statement of study goals

  1. shared understanding of effects of fare, service actions on socioeconomic values

    a. issue definition

b. data collection
c. filling gaps in data
d. evaluation of implications

2. dialogue, feedback evolution of ideas

3. proposals for future action

III. Identify Categories of user; discuss reasons impact evaluation is(or is not) warranted:
low-income persons
students
elderly - not employment related
youth, not school related (break-down: half-fare youth, full-fare youth?)
discretionary riders (shoppers, tourists, entertainment, other?)
commuters - captive, discretionary
handicapped

Data exist for most of the above; where data do not exist, estimates or working assumptions should be made.

IV. Give figures, for such user categories, of ridership prior to 1980-81 fare increases and service cuts, and figures for such ridership subsequent to such increases and cuts. Apportion into trips diverted and trips not taken.

V. Discuss impacts on user categories of trips not taken. (Discussion is expected to be qualitative, due to lack of hard data, but should nonetheless be helpful in identifying comparative severity of impacts on user categories)

VI. Increased dollar cost

A. State, for each user category, the change (absolute and %) in cost of trips taken. Establish a common factor (probably, fare burden/household income) to permit comparison of change in burden of fares borne by each user category.

VII. Discuss impacts on user categories of increase in proportion of household income* devoted to transit fares. Which, if any, increases are negative when corrected for inflation?

VIII. Existing Subsidies

Describe existing fare programs for the benefit of any of the user categories; discuss any state or federal regulations which mandate them. Assess cost to T of these programs, and compute and compare on a per capita basis the effect of these subsidies on user categories.

IX. Mitigation Measures

Identify any user categories which are believed to be either disproportionately burdened (insufficiently subsidized) by the fare structure, or any ways in which the fare structure is believed to inefficiently deliver the present subsidies, and discuss proposals for remedying the situation. Discuss short-hop travellers, especially those needing to link trips. Discuss inconvenience of paying by multiple coins, increased dwell time, increased fare evasion.

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* (or other common factor, as developed)

X. Estimate the impacts of the fare increase on retail trade.

XI. Develop a means of prior evaluation of potential service cuts or fare increases so as to identify and avoid actions having especially severe social economic impacts. Establish the procedure for this (SIR update for fare increases or service reductions; other means for any significant changes in service (c. 116A s. 5 (F 1/2)).

October 30, 1981
DATE

Samuel G. Mygatt for
JOHN A. BEWICK, SECRETARY

SGM:jc

APPENDIX A-4

COMMENTS ON THE DRAFT MBTA FARE STUDY AND RESPONSES

The following are the formal comments which have been received on the Draft Environmental and Socioeconomic Impact Reports of the Fare Increase on the MBTA, dated March 5, 1982, April 1, 1982, and September 1982. Responses as to where information may be found within the final report are provided where necessary. Policy comments are included without response for the reader's information.

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

EDWARD J. KING
GOVERNOR
JOHN A. BEWICK
SECRETARY

Jun 16 10 51 AM '82
PROGRAM
DEVELOPMENT

CERTIFICATE OF THE SECRETARY OF ENVIRONMENTAL AFFAIRS ON THE REVISED DRAFT ENVIRONMENTAL IMPACT REPORT

PROJECT NAME : MBTA Fare Increase
PROJECT LOCATION : MBTA Region
EOEA NUMBER : 4147
PROJECT PROPONENT : Mass. Bay Transportation Auth.
DATE NOTICED IN MONITOR : April 23, 1982

The Secretary of Environmental Affairs herein issues a statement that the Revised Draft Environmental Impact Report on this project adequately and properly complies with Massachusetts General Laws, Chapter 30, Section 62-62H inclusive, and the regulations implementing MEPA.

The original Draft Generic Environmental Impact Report submitted to this office on March 10, 1982, was prepared jointly by the MBTA and by the Central Transportation Planning Staff. The report was prepared in response to the general Scope issued on July 31, 1981 and the detailed Scope issued on October 31, 1982. The revised Draft EIR, dated April :, 1982, was received on April 15, 1982. This revised Draft Report contained much of the key materials which were missing from the original Draft EIR and which resulted in a finding by EOEA of inadequacy of the Draft Report.

1. GENERAL COMMENTS	
The rollback of the rapid transit fare from 75 cents to 60 cents and the Budget action of the Advisory Board has removed some of the crisis pressures from the MBTA management and its ridership. The summer and fall of 1982 should serve as a period to analyse and plan on ways to avoid future crises over funding, fare increases and service cuts, and to provide clear direction to the MBTA to achieve more stable and efficient service to the ridership.	
The Draft EIR follows the MEPA scope fairly closely, although the EIR should contain the scope itself. The report is fairly well organized, and the tables and charts are fairly clear to the reader. A subject Index would also have assisted the reader in looking for desired information. In several copies of the report, page 95 was missing.	• Now in Appendix **A-3**. • Has been added. • Problem corrected.
2. DESCRIPTION OF EXISTING SYSTEM	
The section on existing conditions is a good summary of the MBTA system, although additional tables would be useful to describe the number of rail cars and buses for each line, plus those that are available for daily service. Section 2.9, "Operating Capacity" is listed in the Table of Contents but is not in the text. A good description of MBTA operating capacities is clearly needed in the Final EIR.	• Can be found in Tables 2-2 A and B. • Now may be found in Section 2.7.3. • Appendix **C**.
The differences in Table 2.5 between the two versions of the Draft EIR should be explained, apparently the result of including or excluding considerations of Commuter rail.	• Now explained in Table 2-10.
Cost figures for the MBTA should also clarify how capital costs are treated. Debt service on old bonds and accounting for Federal capital assistance should be included in the overall assessment, as well as the relationship of these factors to depreciation cost.	• In Section 2-5.
Table 2-7 indicates differences in operating expenses per vehicle mile between various transit systems. Why are rapid rail operating expenses at the MBTA three times higher than those for New York City? Five times more than Chicago, 3.5 times Washington, D.C. and three times those of Cleveland. Why are MBTA bus costs twice those of Pittsburg, which is a city with much steeper hills?	• Will be found in the Management Practices Study.
3. RIDERSHIP LOSSES	
The Final EIR should include a description of alternate methods of estimating riders and an assessment of accuracy. The extended CTPS process of estimating ridership was a long and grueling process which few people understand and which is not likely to repeated on a frequent schedule, so that the MBTA can easily monitor ridership trends in a timely manner.	

Public comments received on the ridership analysis should be closely reviewed, with an emphasis on clarity. In addition, consideration should be given to the several detailed questions on the ridership figures, noted in the April 28 , 1982 EOEA statement on the original Draft EIR, as well as the following comments :

- Ridership data from Table 2-2 for 1951-1981 for total system daily ridership seems inconsistent with trends for rapid rail daily ridership for 1950-1980. Table 2-2 shows a loss of only 34,200 daily riders from 1980-81, while table 3-1 shows a loss of 94,600. An explanation is needed.

- Clarify the ridership figures and status of the Symphony station on the Green Line.

- The EOEA scope called for a "Comparison of peak hour quality of service (average speeds, passengers moved per hour) with off-peak performance, and with theoretical operating capacity of a system operating efficiently..." Appendix D deals very briefly with theoretical transit capacity, and rather lamely concludes that "there is no accepted theoretical capacity of a system operating efficiently." The 1977 Program for Mass Transit, Volume II contained a whole chapter on MBTA system theoretical and actual capacities. This information should be presented and used as the basis for the development of ridership-based performance standards for the MBTA.

- A key ingredient in determining capacity is the "crush load" capacity of each transit vehicle. There is a notable discrepancy between the EIR (page D-2) and the PMT (Chap.4, page 2) for the capacity of a Green Line LRV. The EIR figure is 56 seats and 217 standees, while the PMT indicates 52 seats and only 108 standees. The "crush load" has been defined as 1.5 s.f. per standee; what is the measured capacity of a fully loaded MBTA LRV?

- The ridership loss is produced by the difference in the 1981 and 1980 total ridership. Because of the sampling program in 1981, the estimates of 1981 ridership have been assumed to be more accurate than the 1980 figures, for which no sampling data were available. However, the variations in the 1981 ridership figures are perplexing :

November 1981 UNLINKED RAPID TRANSIT TRIPS	January 1982 CTPS	April 1982 DEIR
Adult -- cash	51.2 %	48.5 %
-- prepaid pass	32.5 %	29.2 %
Elderly/Handicapped		
-- 1/2 fare	3.1 %	3.8 %
-- free	7.6 %	11.1 %
Students	4.6 %	5.8 %
Other Free	1.0 %	1.6 %
Total Trips/weekday	337,300	305,700

- Has been corrected.

- Appendix **C** has been re-written.

- See Appendix **C**.

Meanwhile, the surface percentages remained the same but the number of daily surface trips rose from 376,600 to 422,100. Total ridership rose from 713,900 to 727,800 unlinked trips. These variations should be explained, including the allegations that elderly ridership may have been exaggerated.	• The changes in calculations are contained in Section 3.4 and Appendix E.
• How do the annual ridership figures (1980 and 1981) take into account the fact that fare increases occurred during the middle of the year?	• The ridership figures are annual estimated values which need not be adjusted for fare increases.
• The variations in ridership estimates reinforces the need for a more accurate ridership measurement and reporting system, which provides ridership and revenue information in a timely fashion, without the typical delays of 2 months in information processing.	
• On page E-7, a loss of 32,000 daily riders (or 5.3 % of the total) is claimed due to service cuts. How was this figure derived and how does it compare with the 7.4 % figure cited in earlier documentation? The revenue mile data on page 36 indicate a 10% drop in 1980-81 service, as measured by revenue miles.	• The service cut loss was re-calculated with the elasticity analysis contained in Section 3.3.
• ELASTICITY :	
1. The Scope for the EIR explicitly called for a clear explanation of elasticities : "if both arc elasticities and simple elasticities are used in the EIR, avoid commingling them." Nevertheless, on page 43, data are presented on a "range of elasticities that could be applied to Boston." Do these represent arc elasticities or point elasticities? Also, do the fare elasticities on page 126 represent arc or point elasticity?	• The report has been simplified and now only inclues arc elasticities.
2. On page 46, elasticities are shown for various unlinked trips. Are these figures derived from comparisons of 1980 and 1981 ridership? If so, what allowance was made for inflation?	• Elasticities are static measures and are not "adjustable." They are calculated separately for November 1980 and 1981 in Section 3.3.
3. Additional comments on elasticity in the EOEA statement on the original Draft EIR should also be responded to in the Final EIR.	• Has been done with the expansion of Section 3.1.
In conclusion, it does not appear that the MBTA can be more accurate than 10% certainty in estimating its daily ridership. Elasticities are even more uncertain when concurrently with fare increases there are service variations and major inflationary increases in the price of gasoline and overall costs of automobile transportation. The Final EIR should describe methods of improved annual sampling of ridership and to improve regular pass-reader reliability and reporting, as well as more timely production of monthly ridership summaries (RTL-210 data).	• Discussed briefly in Section 7.0.

4. ENVIRONMENTAL IMPACTS

• TRAFFIC CONGESTION	
The methodology to assess incremental impacts on existing traffic congestion and queues is innovative and a worthy assessment of the impacts of additional traffic at key bottleneck points. Table 3 in Appendix F-1 should be clarified and made as consistent as possible with Table 4-1 on page 54. For Table 2 of Appendix F-2, hourly bottleneck capacity is "defined as 10 times hourly capacity," yet in the printed text it is the "hourly capacity at the bottleneck point." Please explain and correct as necessary. On page F-7, how is the average maximum delay measured and over what distance?	• Has been corrected. • Explained in Appendix F-2.
Is there any way of checking the queuing model, such as assessing additional traffic and queue lengths on the Southeast Expressway during the April 9 wildcat strike?	• No, data detailed enough to perform such a check was not collected during the strike.
• AIR POLLUTION	
On page 52, the additional regional air pollution emissions due to the loss of transit ridership is shown for non-methane hydrocarbons, carbon monoxide and nitrogen oxides. However, many autos, especially older models, release Lead Bromide as a particulate emission. Lead being a hazardous heavy metal with a prolonged impact on the environment, the incremental emissions of lead should also be estimated.	• Lead emission estimates have been included in Section 4.2.4 and Appendix F-6.
• NOISE	
The analysis on page 58-59 presumes that the only noise impacts will be from major roadways. If new traffic demand is added to already congested expressways, there is a noted tendency for traffic to divert to local streets and thereby have a more significant impact on residential areas and institutions.	• Section 4.4, Noise Impacts of the Fare Increase.
• ENERGY	
Table 2-10 on page 37 should include the data for 1981 as well, which suggest an additional improvement of 4% in fuel efficiency between 1980 and 1981. How have these improvements been achieved and do they include the closure of the South Boston Power plant? What additional steps are being taken to reduce energy waste and theft? The 1981 energy use reductions would appear to represent about 1/3 of the addition revenues generated by the fare increase as shown on page 32.	• See Section 2.7.1, Energy Use and Efficiency.
If the MBTA improved service revenue mileage by 10% to handle 10% more ridership, what would be the energy efficiency of such a change, compared with autos and private buses?	• See Section 2.7.1 and Appendix F-4, the Marginal Energy Consequences of Changes in Revenue Mileage.

On page 60, the energy consequences of the fare increase are estimated to be an additional 4.7 million gallons per year of increased auto fuel consumption. However, this estimate is based on an overall average of 15 MPH for each vehicle and does not consider the effects of increased congestion on energy consumption. The increased congestion will have an effect on more cars than those directly involved in the mode switch from transit to autos.

The combination of the EIR and SIR can result in useful measures of passenger and energy performance of the MBTA system. The SIR notes on page 116 that the average trip length on rapid transit is 7.1 miles and is 5.2 miles for surface trips. The table on page 115 could then be expanded to include :

	ANNUAL FIGURES IN MILLIONS					
Year 1980 155.6 million passengers	Operating Cost	Total Vehicle -Miles	Total Passengers	Passenger Miles	Cost per Passenger -Mile	Pass-Miles per gallon
Rapid Transit	$106.4	10.11	72.0	486.0	$0.27	-
Surface :						
Streetcar	$ 16.4	5.15	26.9	137.2	$0.12	-
Trolley Bus	$ 3.9	0.81	2.1	10.8	$0.36	-
(TOTAL ELECTRIC	$126.7	16.07	101.0	634.0	$0.20	22)
Diesel Bus	$ 85.8	22.22	58.1	296.2	$0.35	38
Commuter Rail	$ 41.2	5.79	?	?	?	?

The calculation above assume twice the number of riders per streetcar as for bus, on the average, and results in average occupancy of 48 passengers per rapid transit car and 13 passengers per bus. Do these figures check against sample trip observations of average load factors? The figures of 7.1 miles and 5.2 miles for the average rail and surface trips appears to be high, as do the figures for average vehicle occupancy.

- See Appendix F , Energy Consequences of Traffic Congestion.

- These are national figures for round-trip transit values, as now explained in document.

5. ALTERNATIVES

• ALTERNATIVE FARE STRUCTURES

The scope called for past and recent data on the effects of fare increases in other cities. Although a few cases were cited in the Draft report, a comprehensive summary should be provided in the Final EIR

The Draft EIR presenting some remarkable estimates of increased elderly ridership. Table 5-1 on page 84 provides the base data to calculate the incremental cost for each new rider due to fare reductions :

FARE REDUCTION	COST FOR EACH ADDITIONAL RIDER
Elderly : Free Off-peak	20 cents
Free Bus-to-Bus transfer	$2.90
1/2 price for low-income households	$3.15
Free Rail-to-Rail transfer	$4.00

The basic calculations on pp. 70-71 should be reviewed for accuracy. The 1980 elderly ridership of 45,000 (paying half fare) had an average fare of 16 cents (60% paid 10 cents for bus and 40% paid 25 cents for rapid transit) while the 1981 elderly ridership is estimated to have increased to 59,000 for an average fare of 15 cents. These results are not consistent with an assumed fare elasticity of 0.14. The data from Table 2 are not much better : 1980 elderly ridership of 46,300 with an average fare of 16 cents and 1981 ridership of 62,300 with an average fare of 12.3 cents. In either case, elasticities exceed 1.0, which is not a reasonable result.

Regardless of the specific ridership figures, the popularity of the elderly off peak ridership program should be recognized by proper amendment of Chapter 161A of the General Laws, which currently requires that elderly riders pay one-half of the full adult fare on both subways and surface lines.

Programs to increase off peak ridership and spread the service more evenly throughout the day have been proposed. What are the costs of current service per off-peak revenue mile compared to peak conditions? The costs and benefits of off peak scheduling should be assessed on this basis.

- Can be found in Section 5.3.

- Has been reviewed.

- Information was not available.

6. SOCIO-ECONOMIC IMPACTS

Most public comments on the socio economic impact section of the report have been generally favorable. However, the degree and form of subsidy remains unresolved in terms of specific plicy for service and system improvements.

The proposal for a human services or education agency to redistribute subsidized tokens does present certain practical problems. The school program has produced a black market in tokens, as many students sell their tokens for cash. The same result is likely for tokens to the elderly and handicapped.

One key assumption of the Report is that the subsidy is virtually entirely in the direction of low income and disadvantaged persons. The flat fare structure tends to place a larger percentage of burden on lower income passengers. [illegible] trend over the years towards suburban rail transit extensions has tended to provide the suburbs with better service to the detriment of the inner city and also the inner suburbs.

In the Final Socio-economic Impact Report, the EIR should seek to respond to the specific comments received and the implications for optimizing the proportion of subsidized services to various disadvantaged segments of society.

7. MITIGATING MEASURES

This chapter lacks quantitative analysis. There are no figures for standards or for actual performance results. Page [illegible] refers to productivity criteria such as passengers per hour and revenue per passenger mile. How are these factors to be related and what are the characteristics for the existing MBTA system? What are the performance criteria which the MBTA would propose especially for rapid transit, and how well has the MBTA met these goals in recent years?

Detailed comments on load factors, and [illegible] are included in the specific comments of the Study Review Committee and EOEA statement on the original DEIR.

- ALTERNATIVE FUNDING SOURCES

The EIR considers several alternatives to fare increases, including fare collection methods, new taxes and implementation of management rights. The concept which appears implicit in management rights is the improvement of operational efficiency of the MBTA. For the same amount of employees and rolling stock, improved efficiency will generate new riders and new fare revenue. The benefits are two fold [illegible] revenues and [illegible] ridership, with reduced auto tripmaking and associated pollution, congestion and energy impacts. The Final EIR [illegible] explicitly and quantitatively look at measures to achieve efficiency benefits.

- Can be found in Appendix C.

- Addressed in Section 7.0 and tangentially in Section 2.7.3.

The goals should be to utilize trains and buses in the best way to move the most passengers during peak periods, to invest in preventive maintenance rather than the more crippling failure maintenance, to cut back on energy waste and theft, and to improve monitoring of operations in the field.

* CONTROLLING COSTS

The general issue of controlling costs was covered in the EOEA statement on the original Draft EIR, and is considered in more detail in the response to the Draft Management Practices Study.

* * * * * * * * * * *

The Final EIR should include copies of the public comments received on both the original and the revised Draft EIRs and copies of the various scopes issued for the MBTA fare increase. A topical index at the end of the report would also be very useful.

6/4/82
DATE

Samuel G. Mygatt, Jr.
JOHN A. BEWICK, SECRETARY

SGM/SK/ze

May 11, 1982

Comments on the Revised Draft Environmental and Socioeconomic Impact Report of the Fare Increase on the MBTA.

To: Samuel Mygatt, MEPA Office

From: Anne Fanton, LWVM

The League of Women Voters of Massachusetts asks that Secretary John Bewick find the Revised Draft EIR and SIR unacceptable without substantial revisions by CTPS. Despite extensive comments, by SRC members, made at our meeting on March 24th, the Revised Draft is nearly identical to the Preliminary Draft except that missing sections have been inserted. A few other minor changes were made in the text, most not in response to committee comments. It appears that the entire report was retyped and reprinted, which seems particularly wasteful in light of the lack of actual revision.

All of the comments I submitted to you on April 6th are still applicable with the exception of: p.4, the map has been corrected; p.14, MBTA as source added; p.17, Symphony ridership # simply removed (is data valid?); p.23, Zone 2 corrected.

Additional Comments on the Revised Draft:

p.27 - All of the numbers in the top paragraph have been changed, without any explanation. They now do not correlate with the bottom paragraph on same page.	• This section has been recalculated. Error made in previous values had included non-MBTA operated carrier services.
p.28 - The last 4 columns of figures were all lowered, without any explanation.	• Changed.
p.30 - 1981 figures were added but revenue figures still do not correlate with those on p.32! Some explanation is necessary.	• Relates to same error; has been corrected.
p.31 - This chart has been added and is very useful. Also, the source is provided!	
p.34 - Line 10 has been clarified.	
p.36 - 1981 figures were added.	
p. 54 - Figures for additional VMT and regional emissions have been revised upward, without any explanation.	• Lowered, had been an arithmetic error.
p.56 - some changes.	

Socio-economic Impacts,pp.93-127:

General Comments:

The SIR offers some very useful information and there is considerably more source identification than in the EIR, though much of its data still needs [illegible].

to be explained in more detail. One of the primary goals of this study was to define the need for accurate ridership data, to determine the impacts on specific groups of riders when making changes in fare structure or service, to state where there are gaps in such data and offer recommendations for closing these gaps. The Draft SIR does not do this. If ther is adequate data, there is not enough information in the report to verify this; if there is noneedough better data, then it would serve the purposes of the report for the MBTA to make the needs clear. The purpose was to be constructive, not defensive.	
Specific Comments:	
p.93 - The introduction seems well written.	
p.95 - missing; therefore value to users could not be evaluated.	• Has been added.
Section II of the SCope of Work does not seem to have been done.	
Sections III and IV of the Scope of Work call for identification of categories of users and figures for each category. Section 6.2 of the Draft SIR would be much improved if these categories were presented all together in one chart, with percentages on the system.	• Comparable information to create such a chart beyond what is provided in Table
pp.99-101 - The income discussionlis very useful. On p.100, where did the 1981 sampling program? Did the 1981 sampling program categorize riders?	• No, not into income group. The information was estimated as described in Section 6.2.1.
p.102 - How were the school and non/school numbers generated? "It is a fair assumption"; "In 1981, it is estimated" need explanation. An appendix describing the Nov., 1981 sampling program in detail (percentage vehicles for each mode sampled; evaluate it for reliability; discuss other (more reliable?) sampling methods that could be implemented.)	• This memo will be available from the MBTA in a separate technical memo soon after October 1, 1982.
(Refer to Comments below on Appendix E. Note that at the bottom of E-5, it is stated, "Care should be taken when using figures concerning the subcategories of users." Yet, the SIR sues these fidures, has not discussed their adequacy, does not recommend methods of collecting more accurate data to improve the figures, and (apparently) has made assumptions based on these figures.	• Sampling program was an attempt to generate more reliable numbers from 1981 on.
p.104 - Explain the means of estimating elderly ridership. The assumptions in the last paragraph also need substantiation.	• Section 6.2.2 explains the method and assumptions.
Perhaps, considering the data that exists, the author made reasonable working assumptions. More emphasis in this section then should be placed on improving the data.	
p.110 - What evidence is there that 11,500 - 16,700 lost trips went to other shopping centers? The focus was to be on the city's retail trade.	• 1979 shopping trips are estimated through use of the 1978 Wilbur Smith Study and 1981 figures are derived by applying elasticity analysis as shown on Table 6-1 and Table 6-7.
p.115-117 - I am not sure why this work was done. Is this to fulfill Sections VI and VIII of the Scope of Work? Does it? I am confused by this. Also, the Palmere Study (see footnote, p.123) could have been useful resource here.	• The Palmere Study was used and is now properly cited.

p.120, line 4 - This eases past a real legal question re. the elderly fares. State law"requires that ½ fares be charged (not offered) to the elderly at all times."	
p.121 - What was the source for the data on children and students, and on fare evaders? (Source identification should bemmore than just "MBTA". Identify specific study, or means of gathering data.)	• Has been cited where known.
p.121,parag. 2 - I do not believe that the comparative regressivity of the fare burden per household income to various other tax burdens is "outside the scope of this analysis." Since fare increases are most regressive, that is some justification for mitigating measures and for reconsidering certain fare changes.	
p.121 - "Increased fares tend to affect the elderly more...." This is an assumption made prior to the fare increase. A major goal of the SIR was to evaluate free off-peak travel for elderly and handicapped, other mitigating measures and recommend the most effective and the cost-effective!	
Appendix B: A more detailed explanation of MBTA ridership counting procedures and the 1981 sampling program would improve the report tremendously. Recommendations for improvements in data collection could be placed here. Appendix E: E-2, bottom of page - How large was the sample? What percentage of total daily runs for each mode? E-3, top half - Confidence interval? Why? Does the technical appendix provide this information? Could it be added?	• This more detailed study of the 1981 Sampling Program is contained in a separate technical memo to be released by the MBTA in the Fall of 1982. It contains all requested information.

The League askd that Sec. Bewick require CTPS and the MBTA to provide the additional information requested in written comments on the EIR and SIR, before accepting the draft reports. We thank you for the interest that EOEA has shown in this process, and the substantial time and effort that has been dedicated constructive improbements to the MBTA.

April 6, 1982

Some comments by members of the Study Review Committee on the Preliminary Draft of the Environmental and Socioeconomic Impact Report of the Fare Increase on the MBTA:

GENERAL COMMENTS;	
Clark Frazier: 1. The document needs a stated policy. If policy has been enunciated in other certification documents, it should be included and referred to throughout this document. For example, would the policy suggest that decreasing VMT is a goal? There is no sense that permanently declining ridership is bad.	• Has been included; see Section 1.3.
2. We are expected to assume that much of the data is valid. (Lewjean Holmes stated that much of the data was taken directly from the MBTA with no attempt to validate it.)	• Attempt has been made to cite sources and check them where possible.
3. The document contains biased assumptions.	• Assumptions have been stated clearly where possible and are based on all available data.
Lewjean Holmes (?): The figures in various tables do not correlate. There should be consistency among figures within the document.	• All tables have been checked.
Anne Fanton: 1. Suggest a complete reference list at the end of the document with all of the facts footnoted. Any statements, assumptions and conclusions within the text should be defended in detail. It is impossible to tell how thorough the research was.	• Footnotes have been added throughout the document.
. . Remove politicized statements; for example on page 12, the last sentence is inappropriate and unnecessary. Other examples are cited below.	• Has been done.
3. The final conclusion that the MBTA must depend in the future on increased fare revenue, rather than, for example, on alternative tax revenues, is totally unsubstantiated and does not seem to be drawn from the data in the previous sections of the document.	• Discussed in Section 5.3.
Betsy Johnson: Overall, the E.I.R. says little new that can really help in making policy decisions; section 4 (Environmental Impacts) especially is merely a "plugging in" of numbers into formulae. Analyses do not go anywhere. Are the decreases in ridership, increases in pollutants, etc. contrary to policy?	• See Section 4.2.5 and Section 4.3.
Ann Hershtang: Tables are expected to explain themselves.	• Additional explanations have been provided in many figures and tables.
SPECIFIC COMMENTS:	
1. Appendix A - Summary of Studies (Scope 1B.):	
Frazier, Polly Russell, Fanton: more detail is needed, and a reference list at the end.	• See footnotes and bibliography.
Fanton: detail is needed in: p. 1, parag. 1: "Recommendations of the Governor's task force included ways to improve efficiency and reduce the deficit." p. 2, parag. 2 (all): beginning "The special commission...." p.3, parag. 2: explain "some concerns...about the distribution of the state's share of deficit to express service." p. 4: more detail in the top paragraph.	• Addressed briefly in Sections 2.7, 7.1, and Appendix A; also in Management Practices Study.

2. Section 2 -Existing Conditions (Scope I):	
Fanton: p. 4: This map is correct except for Acton and Carlisle.	• See Figure 2-2.
p. 5: define rapid rail and light rail.	• See Table 2-1.
p. 6: show Mattapan trolley line.	• See Figure 2-3.
Scope 1.4.: p. 10: remove political overtones - "Recently the MBTA (has been forced to reduce) reduced service."	• Removed.
p. 11: Green line number of vehicles?	• See Table 2-8B.
p. 12: Is this correct? Is bus service only 12-13% of what it was?!	• Yes, and see Section 2.4 for "de facto" service cuts.
There is nothing new here at all. A chart which clearly demonstrates 1979, 1980, and 1981 service levels with exact changes would be far more useful.	• See Table 2-6
Please see Scope 1.6.: Ridership. There are no ridership percentages in geographical parts of the system (necessary for the S.I.R.)	• In Tables 2-4 and 2-5.
p. 16,"Figure 2-6...notes the change from December 1980." how does it do this? Why is there no information on bus ridership?	• It does not; has been changed in the text.
Holmes: p. 17, Figure 2-6: stations that were closed have ridership noted (eg. Symphony). Are the numbers accurate?	• No, figure has been changed.
Steve Kaiser: p.18: Do the number of riders include pass users? This should be broken down.	• Yes, it does.
Hershfang: What is the resource for this data? Many tables suggest questions which are not commented on. All tables need additional information (eg. p. 37 closing of So. Boston power station was significant and yet there is no reference made to it. The energy service data does not explain itself!)	• Now explained in Section 2.7.1 on Operating Trends.
Fanton: p. 20, line 13: correct "the state passed legislation providing (a reduced fare) half fare to citizens over the age of 65."	• Changed.
pp. 22-27: Please refer to Scope 1. 3.:	• Contained in 2.5.
This work is incomplete. The average fare is not compared to other cities and is not broken down into different fares for different passengers (eg. elderly, student, etc.) so that changes in the fare structure can be understood. All data sources need to be referenced.	• Information not available; will be in Management Practices Study in more detail.
Committee member?: p. 23: Zone 2 is incorrect.	• Corrected.
p. 27: Factor in length of trip as well as cost/trip. When talking about costs, footnote what is meant by "costs."	• Has been detailed, see Section 2.5.
Fanton: p. 30: The figures in Table 2-6 do not match those on p. 32 in Table 2-8.	• Has been corrected.
Refer to Scope 1. 5.:Analytic methods is not done at all.	• In Section 3.1, 3.3, and 3.4.
Scope 1.7.: Operating Trends is incomplete. There are no conclusions. There may be "no theoretical operating capacity of a system operating efficiently" but CTPS can draw some conclusions from their examination of data. This section as written is useless.	• See Section 2.7.
3. Ridership Impacts of Recent Fare Increase (Scope II.):	
Russell: p. 40: The first sentence is blatantly political.	• Has been changed.

Fanton: This section is totally unacceptable! Please refer to Scope II. 1.-7. Numbers 1,5 and 7 are completed. Numbers 2 and 3 lack sufficient detail and there is no comparison with predicted effects. Numbers 4 and 6 are not done at all.	• No. 4 is presented in Section 3.2.4, No. 6 is included in diversion study.
The conclusions are unclear, lack detail and back-up data.	• Sections have been strengthened.
The ridership figures on p. 44 are new and leave serious concern as to their validity. The committee has neither the January CTPS report on ridership nor Appendix E. and I question whether there is any commitment at the MBTA to accurate information or improvements in data collection.	• See Section 7.1.3.
4. Environmental Impacts (Scope III.):	
Fanton: The air quality analysis methodology in the appendices needs to be more clearly written. Appendix F-2 is difficult to read and lacks data. Appendix F-4 ends in mid-sentence.	• Some re-writing has been done in an attempt to make the work more clear.
Was Scope III.2. completed?	• Detailed accurate data not available.
Scope III.6. (Energy) is not evaluated in a useful way.	• See new Section 2.7.1.
p. 50, 4.1.: How was the number 85,000 (decrease in daily passenger trips) arrived at?	• Diversion methodology is detailed in Appendix F-1.
p.57: last two paragraphs are very clear.The top line on p. 58 implies that the effect is not significant. Is that the conclusion?	• See new Section 4.3.
p.58, Energy: Conclusions? detail?	• Now in Section 2.7.1 and 4.3
Johnson: p. 50: It is unclear where the all-important 85,000 net decrease of daily passenger trips has come from, but all of the resultant numbers depend on this.	• Comes from estimates made with the assistance of 1981 Survey.
Some analysis of the pros/cons of EPA's MOBILE 2 program and volume 9 method as modified by DEQE is needed.	• Has been taken out.
pp.57-58: Most important, what is the significance of a 0.5% increase in regional daily VMT? What is the significance of an additional 200 tons/year of HC (actually it is unclear (p.57, sec.4.3.4.) if it is the HC or ozone or which standard which will be exacerbated.) The E.I.R. states that "the increase in emissions due to the fare increase is less than half of one percent of the reduction needed..." How significant is this?	• The significance of these values is discussed briefly in Section 4.2.5.
Hershfang: pp. 52-53: The arborway line is missing.	• ?
The League asked for comparative November 1980 and November 1981 garage use figures as maintained by various garages and traffic data for major radial highways, as an actual way of determining whether automobile use into the region had increased. May those be included?	• Data is not available on a regionwide, reliable basis.
5. Alternatives(Scope IV.):	
Fanton: p. 60, 5.1.: a very political section!	• Has been changed somewhat.
p. 66: The last sentence in the top paragraph does not follow logically.	• Corrected.
p.71, bottom of page: Doesn't the 1978 Passenger survey provide information "regarding the incomes of transit users and general travel patterns of the poor?"	• Section 6.4 on Fare Burden.
A 1977-78 Nationwide Personal Transportation Study conducted by the U.S. Bureau of the Census for the Federal Highway Administration provided such information. This is the kind of research necessary to the E.I.R./S.I.R. and some of this information is available right in the CTPS library!	• Information from this source is used extensively in Section 6.4.
p.85: description of fare structure alternatives is useful. Please add bulk sale of tokens as a possibility.	• See Section 5.4.2.

Hershfang: p. 67: Impact of...Elderly - Could this be in a chart so that the various ridership figures - 59,000 45,000 27,000 32,000 and revenues and savings could be easily correlated and understood? Also, are these figures based only on "weekdays?" How many days a year?	• Now in Section 5.3.2.
p.68: seems to change to another subject in paragraph 2, and needs a new heading.	• Has been changed slightly.
p.71, Section 5.3.2.: Reduced fare....Groups - The student fare discussion here is about raising not reducing them. The Boston LWV requested that you include an analysis of the possibility of and consequences of providing ½ fare rides for children up to 18 at all times, not just school hours. We again request it.	• See Section 5.3.2 for an expanded discussion.
6. Socioeconomic Impacts:	
Fanton: No S.I.R. Wasn't much of the ridership data necessary for the S.I.R. also necessary for the E.I.R.? How could one be completed without the other?	• Now included as Section 6.
7. Mitigating Measures (Scope V.):	
Fanton: p.96,7.1.3.: Service Restoration: What service was restored during the summer and fall of 1981? Refer to EOEA #4147.	• See Table 2-6.
p.98,7.2.2.: Alternative Funding Sources: What references were used?	• See Bibliography.
p.99, last sentence in 7.2.2.: Fare increases are also "met with opposition." I suggest a review of Anthony Palmere's "Financing the MBTA" in the CTPS library. It contains detailed information on the impacts of fare increases and other alternatives.	• Source was reviewed and appropriate changes were made.
p.101: There is a total lack of information regarding the impact on ridership and the environment of fare indexing!	• ?
8. MBTA Expectations (Scope VI.):	
Fanton: p.102: "Increased reliance on fare revenue as a means of funding transit service can be anticipated" is an unsubstantiated conclusion. Was this section written in a void?" This section was to draw its conclusions from all of the data and previous conclusions in the document.	• Yes, this section was originally written separately and has been better incorporated in final report.
Anne Fanton	

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

EDWARD J KING
GOVERNOR
JOHN A BEWICK
SECRETARY

CERTIFICATE OF THE SECRETARY OF ENVIRONMENTAL AFFAIRS ON THE FINAL ENVIRONMENTAL IMPACT REPORT

PROJECT NAME :	MBTA Fare Increase
PROJECT LOCATION :	MBTA Region
EOEA NUMBER :	4147
PROJECT PROPONENT :	Mass. Bay Transportation Authority
DATE NOTICED IN MONITOR :	October 7, 1982

The Secretary of Environmental Affairs herein issues a statement that the FINAL Environmental Impact Report and Socio-Economic Impact Report on the MBTA fare increase will be deemed to comply with Massachusetts General Laws, Chapter 30, Section 62-62H inclusive, and the regulations implementing MEPA, upon submission of a revised report meeting the following conditions :

1. Although the Final GEIR included and adequately responded to comments on the Draft EIR from EOEA (April 4, 1982), MAPC and the Study Review Committee, it did not include or respond to the following comments on the Draft Report :

* DEQE		April 21, 1982
* American Lung Association, Betsy Johnson		March 24, 1982
* Sierra Club	Original DEIR	April 21, 1982
	Revised DEIR	May 21, 1982
* Conservation Law Foundation		April 21, 1982
* Clark Frazier, S.R.C.		April 21, 1982
* Ann Hershfang, Boston L.W.V.		undated

The Final GEIR should be revised to contain these comments and respond to them.

2. The Summary of the Final GEIR (Section 1.2) was incomplete and did not reflect the high quality of analysis that went into the underlying document. The Revised Final GEIR should contain a complete and accurate summary.

3. Paragraph VB of the July 31, 1981 MBTA memorandum provides that :

> *"The mitigation and policy alternatives that are required to be identified by the MBTA will be binding upon the MBTA, unless the MBTA can show by 'clear and convincing evidence' why it has rejected those measures."*

The revised Final Generic EIR should contain a description, with page citation, of the mitigating measures identified in each of the three reports (see especially EIR pp. 119-128 and the Management Practices Study).

UPDATES :

Paragraphs IIB and IIIB of the July 31, 1981 Memorandum provide that the EIR and SIR will be updated each time that MBTA raises its fares or makes a major reduction in service. The next update, which should assess the environmental and socio-economic impacts of any new fare or service actions under consideration, should also respond to all comments filed on the Final EIR/SIR, and should report on the MBTA's success in implementing measures previously committed to. Three copies should be filed with this office, and the Update should be made available for the usual 30-day public comment period following publication in the Monitor.

Attached are comments on the Final Generic EIR/SIR.

December 27, 1982
DATE

Samuel G. Mygatt, for
JOHN A. BEWICK, SECRETARY

ANTHONY D CORTESE, Sc. D.
Commissioner

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Quality Engineering
Division of Air Quality Control
One *Winter Street, Boston* 02108

April 21, 1982

RECEIVED
APR 26 1982
OFFICE OF THE SECRETARY OF
ENVIRONMENTAL AFFAIRS

Mr. Samuel Mygatt
Executive Office of Environmental Affairs
MEPA Unit
100 Cambridge Street
Boston, MA. 02202

Dear Mr. Mygatt:

My staff has reviewed the "Draft Environmental and Socioeconomic Impact Report of the Fare Increase on the MBTA." The basis of a consistency determination is an assessment by DEQE of the project in terms of the transportation project review criteria contained in the Transportation Element of the Massachusetts State Implementation Plan for Air Quality (see attachment) The criteria and the results of their application are as follows:

1. Consultation with the Department of Environmental Quality Engineering

   DEQE has been involved in the consultation process with CTPS and the MBTA since the study initiation. We participated in the project's scoping, and the actual preparation of the respective air analysis. This criterion has been met.

2. Performance of an adequate analysis

   Microscale and mesoscale analyses of the project were conducted. The microscale analysis was performed jointly by DEQE and CTPS utilizing the EPA Volume 9 modeling technique as modified by DEQE, traffic and meteorological input evaluated in terms of the report's documentation appear to represent worst-case conditions. Conservative background concentrations were based on DEQE guidance. DEQE finds the analysis adequate and in compliance with this criterion.

3. Hydrocarbon emissions

   The results of the mesoscale analysis is the basis for assessing a project relative to this criterion. The mesoscale analysis of the project indicates that hydrocarbon emissions associated with the fare increase are greater (200 tons/year) than those associated with the no fare increase policy. It is further noted that given the MBTA Fare Policy as described in Section 8.0 MBTA Expectations for Short-and Long- Term Service and Fare Stability Over The Next Decade, the problems as noted above may be further exacerbated. In light of these findings, commitments to mitigating measures are required in order to be consistent with this criterion.

- This has been added and is in Section 7. and in the Summary table in Section 1.

4. Carbon Monoxide

Assessment of this project relative to the substantive CO criterion must be made in terms of reasonable progress in eliminating existing violations and evidence of no violations at sites where violations do not currently exist, since both situations are found within this study. The analysis indicates that none of the intersections exceed the 1-hour standard of 35 ppm, although conditions at Leverett Circle approach 30 ppm. The 8-hour standard of 9 ppm would be violated at 3 intersections with the increased traffic volumes generated as a result of the fare increase. It is further noted that given the MBTA Fare Policy as described in Section 8.0 MBTA Expectations for Short-and Long-Term Service and Fare Stability Over The Next Decade, the problems as noted above may be further exacerbated, in fact may spread to other intersections. In light of these findings, commitments to mitigating measures are required, in order to be consistent with this criterion.

In summary, the MBTA Fare Increase EIR as presented meets only two of the four transportation project review criteria. Therefore, DEQE finds the project and its resultant air analysis, as presented in the Environmental Impact Report, inconsistent with the Massachusetts State Implementation Plan, until such time as the MBTA addresses the requisite CO and HC mitigating measures.

Very truly yours,

Kenneth A. Hagg
Director

KH/HOB/efj.

Enc.

cc: Donald Hegathlin, MAPC
Arnold Soolenan, CTPs
James O'Leary, MBTA
Anne Fanton, LWV

- See Appendix A-8.

- Section 7, Mitigating Measures, indicates the status of the commitments.

1. BACKGROUND

The basis for a consistency determination for a highway project by DEQE is an assessment of that project and its environmental documentation in terms of the following project level criteria:

- consultation with the Department of Environmental Quality Engineering in the early phases of *project development*. Such consultation shall lead to agreement on the types of analyses to be performed and on the key assumptions to be used prior to performing the analysis.

- performance of an adequate air quality analysis. In terms of project development, decisions on the methods and assumptions to be used in the air quality analysis shall be reached on all major action projects prior to the major action designation.[2] Projects which are designated as *categorical exclusions*[3] and approved by FHWA shall be presumed to be consistent. Likewise, transit projects shall be presumed to be consistent. However, if a categorical exclusion project costs over $10,000,000, such project will be presumed to be consistent unless that presumption is rebutted by DEQE or the *MPO*. (See rebuttal criteria page.) Projects designated major actions prior to January 1, 1979 and for which agreement on the methods and assumptions used in their air quality analysis has not been reached, will be handled on a case-by-case basis.

- hydrocarbon emissions from the preferred alternative should be less than those from the no build case in both the short and long term; in cases where *hydrocarbon emissions* from the preferred alternative are greater, then all reasonable and feasible hydrocarbon reduction/mitigating measures shall be included.

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[2] It was advised at the time of drafting the 1978-1979 DEQE-MPO Memoranda of Understanding on Transportation-Air Quality (MOU), the device by which affected agencies adopted these criteria, that agreement should be reached on analysis methods as early as possible in project development, e.g., prior to the major action determination. In practice, this has come to mean prior to the preparation of an environmental document. The MOUs will be revised to reflect this change, as part of the 1982 SIP revision.

[3] The 1978-1979 DEQE-MPO Memorandum of Understanding on Transportation-Air Quality (MOU), referred to categorical exclusions as non-major actions in accordance with FHWA/UMTA regulations. These regulations have since been changed and the MOU will be revised to reflect this change, as part of the 1982 SIP revision.

March 24, 1

TO: Ann Tanten, MBTA Study Review Committee Chair
FROM: Betty Johnson, environmental programs director, ALA of Boston
RE: Draft E I R of MBTA fare increase

1. Overall the E.I.R says little new that can really help making policy decisions Especially section 4 is merely "plugging in" of numbers into formulae.

2. It is unclear where the all-important 85,000 net of daily passenger trips has come from - but all of the resultant numbers depend on this

3. Some analysis of the pros/cons of EPA's MOBILE program and Volume 9 method as modified by DEQ is needed

4. Most important, what is the significance of a 0.5 increase in regional daily VMT What is the signif. of an additional 2000 tons/year of HC (actually, unclear (p. 57, sec 4.3.4) if it is the HC or ozone which standard which will be exacerbated) The EIR that "The increase in emissions due to the fare increase is less than half of one percent of the reduction needed p 57-58. How significant is this?

- See Appendix E, Estimation of Ridership losses The change in weekday transit ridership was estimated by dividing daily revenue, before and after the fare increase, by an estimate of the average fare paid by each rider. The loss in ridership cited in the preliminary EIR has been adjusted to 90,200 passengers based on a recent analysis of lost ridership experienced during the reconstruction of the Red Line's Dorchester Branch (DRTX Project).

- This method was decided upon by the groups who agreed upon the work scope. For more information on this topic a suggested source is:

  Emissions Forecasting Methodologies
  California State Air Resources Board;
  Evaluation and Planning, Sacramento,
  1974, available from N.T.I.S. PB-238259/
  6ST.

- This is explained in the summary section on Environmental Impacts and in Section 4.2.5.

SiERRA CLUB · New England Chapter
3 JOY STREET, ROOM 12, BOSTON, MASSACHUSETTS, 02108 · 617-227-5339

April 21, 1982

Comments on the Environmental and Socioeconomic Impact Report of the Fare Increase on the MBTA -- Preliminary Draft of March 5, 1982

This report was prepared by the Central Transportation Planning Staff. It consists of eight sections and seven appendixes. Section 6, Socioeconomic Impacts, and appendixes D and E, Problems, Estimating Ridership, and Estimate of Ridership Loss were not included in this draft, making an evaluation of these estimates based on the information that was included, impossible.

The Sierra Club finds the Preliminary Draft of the EIR unacceptable. The report does not carry out its introductory statement, "an analysis of environmental impacts associated with a fare increase." The report fails both in respect to analysis and to presenting environmental impacts.

The report is descriptive, containing a collection of documents and summaries of previous information. Relationships and effects on the environment are not analyzed.

Instead of presenting an analysis of environmental impacts, the report presents descriptive statements of the T's justification for fare increases (and service cuts) and promise that the T is making efforts to improve operating efficiency through the application of management rights and modern technology. The ten pages (out of the report's 105 pages) devoted to environmental impacts are vague and obscure.

This tunnel vision apparent in both the language and emphasis of the report focuses on the costs of operating the T in a time of inflation and decreasing tax funds. This is part, and an important part, of the problem of providing mass transit in the Boston area. The report lacks any vision that the MBTA has the opportunity to provide the most cost-effective and efficient way of moving people in a crowded urban situation. The report ignores what every resident within the MBTA area faces:

* the greater cost of building and maintaining highways
* the loss of tax money when valuable land is used for highways and parking lots
* the inflationary impacts on the real dollars of personal incomes
* the health hazards of residing in a congested urban area

The Sierra Club is very disappointed that this after-the-fact EIR doesn't present a balanced view of transit and doesn't provide the promised detailed information about environmental impacts. We expected important information which would provide a basis for policy direction helpful to the T. Decisions made by the MBTA now may affect residents of the greater Boston area for years to come.

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- Environmental Analysis and the environmental impacts of the increased (projected) VMT are a major portion of the final draft report.

- The work scope focuses on the MBTA budget and ridership problems, environmental impact of a chosen alternative, and mitigating measures to these impacts as they can be implemented by the MBTA.

Sierra Club Comments on MBTA Draft EIR -- page 2	
Data and results presented in this report are not credible. Much is inconsistent , self-serving, contradictory, or clearly wrong.	
An example which demonstrates erroneous analytic technique: Table 2-1 MBTA TITLE VI information on page 11 purports to give the average age of the MBTA bus fleet. This trivial exercise in mathematical analysis is simply wrong.	
In this case, the data presented permit both a correct analysis and a reconstruction of the incorrect one given. The average age of the bus flee is computed in the EIR by averaging the average age of the busses assigned to each garage. The average age of the busses at each garage vary from 3.7 to 15.3 years. Because the number of busses assigned to each garage varies from 61 to 207 the fleet average age given (3.1 years) is wrong. The correct calculation which is found by weighting the average at each garage by the number of busses assigned to that garage, is 7.9 years.	• Has been corrected in subsequent review.
The implications for the credibility of the Draft EIR are devastating, because virtually all of the essential data and assertions are unsupported. If such trivial analysis is performed so incompetently, then no unsupported statement should be believed.	
We conclude that this Draft EIR should be withdrawn immediately and the mandated study be performed by competent and disinterested persons.	
Following are several areas where we have found serious problems:	
DATA	
Incorrect Data The 1981 Fare Structure Figure, Figure 2-9A page 23 is incorrect. The Zone 2 Fare should be $1.12½ instead of $1.00. Zone 3 Fare should be $1.50 instead of $1.25. The Sierra Club is alarmed that the ridership loss figures were estimated on the basis of such incorrect MBTA information; ridership loss might really be around 25% .	• Has been corrected in subsequent review. • Correct fares were used in the analysis.
Sources Omitted The report should be explicit about identifying the source of the data used. At the very least, a section should describe the surveys which produced ridership estimates, the data which was derived from these surveys and data which was derived from secondary estimates.	• Has been better documented. All tables include sources and additional information has been added to Section 2 Ridership Trends.
Missing Calculations How were the ridership loss figures presented in Section 2 turned into estimates of automobile trips in Appendix F? The assumptions are interesting, but it is difficult to see how these numbers have been used to produce the data presented in the charts.	• See Appendix F-1.
Confusing Presentations The Tables presented in Section III are confusing and contradictory.	• Have been revised and explained more clearly.

Sierra Club Comments on MBTA Draft EIR -- page 3	
Contradictory Data Ridership numbers, using totals from Table 2-3 and Table 2-4 on pages 13 and 19 contradict the ridership totals shown in Figure 2-5 on page 15. The combined totals from Tables 2-3 and 2-4 show a decrease of approximately 53,000 between 1979 and 1980. Figure 2-5 shows an increase of approximately 30,000.	
Estimation Techniques not Specified The 1980 and 1981 figures for an average fare are not directly comparable to those prior to 1980, due to changes in estimation techniques. The average fare is an estimate of the "true cost" supposedly to facilitate comparisons but the changes in estimation are not described.	• This is now explained in the report, Appendix E.
Assumptions	
All assumptions should be clearly noted as such, and sources from which they were derived should be indicated.	• This has been done where possible.
The report claims that relative response to fare change does not depend on both the absolute and proportional magnitude of the change. The impacts of modest hikes cannot be generalized to more drastic ones, since a drastic hike is not typical.	
This EIR presents the belief that lost T ridership immediately join carpools!	
The increases in VMT reported on page 51 are key to the air quality analysis. The estimates presented cannot be evaluated without an explanation of assumptions. However, the data in Appendix F is cited without sources, and is not tied to the ridership figures presented earlier in the report. Which transit lines are considered to be in each corridor? Does Table 2 show the proportion or number of trips?	• Assumptions have been added where they would be useful. • Sources are now provided. • Transit lines are not divided by corridor. Corridors are based on origins and destinations. • Table shows percentage of trips.
Missed trips are assumed to have the same effect as service cuts in making further adjustments to fare inelasticity. This is a very questionable assumption since service cuts were designed to minimize a decrease in ridership. Missed trips and unpredictable service can be devastating to peak ridership.	• This has been further expanded in Sections 2.4.1 and 3.0.
Omissions	
Analysis of energy impacts	• Now included in Section 4.3.
Collections of air pollution data	• Original air pollution data collection was not included in the work scope. Forecasts of emission changes was the method chosen to estimate this.
Documentation of air pollution increases, specifically potential impacts of violation of HC standards.	
Salient points from the TESTP analysis	• See Section 4.2.1 and Appendix F.
Analysis of health impacts on urban residents	• See Section 4.2.5 and Appendix F-1.
Survey of riders to collect ridership input on alternatives to maintain or decrease ridership	• See Section 4.2.5, health effects are assumed to be considered in examination of emissions vis-a-vis standards. • Alternatives are contained in Section 5. A survey was not conducted to determine riders' concepts on alternatives.

year in an attempt to minimize the environmental effects of the fare increase. However, no data is provided to support the estimates made. The resulting estimate of the amount of additional pollution to the Boston area as stated in the report, could be ten times less than the actual pollution. We cannot look at these numbers and conclude that insignificant environmental degradation occurs because of the MBTA's fare and service policies. In fact, the air pollution problem in Boston is such that even smaller increases in pollution result in increased hospital admissions and mortality, according to Dr. Betty Ann Brady, Children's Hospital. Therefore, the MBTA should be compelled to take steps to increase its ridership and should not be allowed to cause ridership to decrease.

Comments on Section 5

The Sierra Club finds that all of the material used in this section was available prior to the 1981 fare increase. The substance of the material in Section 4, limited though it is, was also available prior to the fare increase. The Sierra Club sees no reason why this information was not used by the MBTA prior to the fare increase.

This section does indeed "identify several alternative actions to the fare increase." The picture is not complete.
For example, reports show that the Washington DC peak period surcharge has been successful. This option is not mentioned in this section. Possible this method would be more successful in the Greater Boston area than in other cities. Certainly the two paragraphs covering this subject cannot be considered as definitive.

The fare alternatives are summarized in a cursory way in a narrow framework with uncited subjective judgments. Some cities have found good transit matches. Solving this problem will require more than this limited 23-page summary. When this report thoroughly and completely spells out all the impacts and problems for the MBTA, experts in the field might help the MBTA in developing a workable combination of alternatives.

Section 6 Mitigating Measures

We hope the T will make the promised improvements, such as implementing their already adopted service standards.

The public is likely to object to any cost-of-living fare increases until total operating costs are more reasonable.

In considering the alternatives which can provide the funds needed by the T, a complex economic picture must be examined.

In addition to streamlining the T's operating costs:
since 1/3 of the T's budget is fixed, sharp service cuts and steep fare increases may not be cost effective
* The T is a service which can save taxpayers money in other ways.

- By using primary standards for air pollutants, it is felt that health effects are inherently considered.

- This section has been expanded.

Sierra Club comments on Draft MBTA EIR -- page 5	
page 25, last paragraph; It is hard to see how average fares relate to total linked trips. It would help if data describing the proportion of total linked trips can be ascribed to discount fares.	• Also, provided in CTPS Technical Report No. 39.
Page 29. Figure 2-10 is disturbing because it doesn't present the current picture. The upper chart apparently stops in May, 1980. If brought up to September 1981 the average fare per passenger would look quite different.	
Page 37. How did the T achieve the fuel efficiency shown in Table 2-10? It's clear that fuel consumption should be lower with service cutbacks. The statement that fuel efficiency has increased by 9% is unsupported.	• See Section 4.3 on energy use.
Comments on Section 3	
We cannot accept the present preliminary estimates of ridership loss.	
1. Evaluation of the ridership loss estimates cannot be made without Appendixes B and E.	• Now included.
2. MBTA ridership loss figures are in doubt. On page 4 it is assumed that 53,000 fewer trips were made because of the August 1981 fare increase. On page 50, a ridership loss of 27,000 from the first fare increase is indicated. This is the first and only mention of this number. Table 2-3 on page 13 lists a decrease of 55,000 on rapid transit alone in 1980. Where did the 27,000 come from? Why wasn't it mentioned before? What relation does it bear to the 55,000 in Table 2-3? We think the figure of 53,000 could be too low.	• See Appendices B and E including the DRTX Memo for a clarification of these numbers.
3. The whole discussion of elasticity is not really useful to this EIR. Elasticities should only be used for a projection. The elasticity arguments are circular. The ranges of elasticities on page 43 omit "arc" or "pt", so comparisons of the numbers on page 47 are impossible. There are serious difficulties in computing a single elasticity.	• This has been clarified in Section 3.1.
4. The statement that "Rapid transit elasticities are still significantly higher than expected... implies that service reliability might have been acting to discourage ridership" (page 47) should be examined further.	• This is discussed briefly in the report in Section 3.1.
5. Calculating even a gross ridership loss figure requires estimations of estimates and assumptions on assumptions. Under these conditions, different sets of assumptions must be presented and the range of estimated losses published. We do not accept the ridership loss estimate of 9.6%, four parts in one thousand below the trigger level for fare adjustments, which appears in this EIR.	• See CTPS Technical Report No. 39 for details on the assumptions.
Comments on Section 4	
Overall the EIR presented the best case outcome of the environmental effects of loss of ridership due to a fare increase. The report attributes much of the loss of ridership to the service cuts of the same	

Sierra Club comments on MBTA Draft EIR -- page

Consideration of all options "Cost of MBTA service" section 2-6, should include some information on deficits per revenue vehicle. The T leads the nation with an operating deficit per revenue vehicle of almost $97,000. The range for five systems larger than the T is $30,000 --- $57,000.	
BIAS The EIR takes an unreasonably narrow view of the problems presented by the package of actions.	
Lack of Policy Framework. Without any stated transit policies it is impossible to evaluate the implications of the information in this report. In one section the report suggests that riders should be expected to pay total costs through fares. In another section on page 66, NYSDOT warns that ridership losses are not reversible. Without a policy framework, the number and selection of statements can bias the report.	• This has been added in Appendix A and in the summary.
Emphasis The ten pages out of a total of 105 allotted to environmental impacts cannot deal with the neccessary details and analysis. Many details of environmental impacts are omitted while we learn about nine bus garages and that the orange line proceeds northward.	
Partiality Explanations given support T actions, rather than specify problems so that better solutions can be developed.	• An attempt has been made to be more impartial and constructive in generating solutions that are feasible.
The many discussions of inflation and fares hammer in the fact that whether the T management was unaware of inflation until 1980 or unable to plan in the face of their own information. Reasons for not raising fares for several years are not given. It may be that past T management decided that it was politically expedient to rely on Federal and state tax funds. No hint is given that the T could have responded to financial problems in 1980 and 1981 by examining all available options, including recommendations from from an EIR prepared in advance of any fare increase or legislative alternatives or streamlining the costs per passenger "increasing much faster than inflation")(page 27).	• See the section on Findings and Recommendations in Section 1.
Comments on Section 2 This section would be easier to comment on if some data were further evaluated.	
page 12. Shouldn't the next to the last sentence read "12% and 13% less than that provided in 1980?"	• Yes, it was changed.
page 16, last paragraph. How does this data compare with the Wilbur Smith surveys? Why not pull out the bus ridership figures?	• The data is from the Wilbur Smith survey.
page 22 top paragraph. **Passes** should be mentioned prior to this: how many are sold, their cost before the 1981 fare increase, and perhaps a comments about the difficulty in measuring the real number of riders and expenditures.	• Pass information was consolidated for purposes of estimating ridership. For more detail, see CTPS Technical Report No. 39: "MBTA Fare-Mix Sampling Program: Analysis and Documentation."

Sierra Club Comments on MBTA Draft EIR -- page 7

Downtown and other business areas serviced by reliable public transportation may be revitalized thus producing more profit and taxes. Taxpayers will also save money by not building and maintaining more highways.

* *

The Sierra Club would like to see an inexpensive alternative to increase ridership implemented:

The T would post schedules and maps in appropriate places
Drivers and T personnel would provide schedules.
All transit would arrive on schedule!

Some Comparisons of the MBTA with the Chicago CTA and the Philadelphia SEPTA -- from Section XV Report by Urban Mass Transit Authority, 1978-1979 data

	MBTA	Chicago CTA	Philadelphia SEPTA
Annual train miles/ operator	5,000	7,100	14,000
Annual car miles/ operator	13,500	23,000	53,000
Annual car hours/ operator	340	1100	3100
Operating costs/ car mile	$11	$1.70	$3.40
Operating costs/ car hour	$250	$67.50	$67.50
Administrative employees/car	1.05	.3	.35
Total employees/ car	7.5	3.2	3.5
Annual operating costs/car	$238,000	$90,000	$80,000
Total Transit System			
Public assistance dollars/vehicle	$95,000	$45,000	$55,000
Ratio of fares: operating costs	25%	51%	49%

- The Management Practices Study addresses this in its Appendix A, Section III and presents a detailed comparison of staffing and expenditure levels for these other systems.

SIERRA CLUB · New England Chapter
3 JOY STREET, ROOM 12, BOSTON, MASSACHUSETTS, 02108 · 617-227-5339

May 21, 1982

Comments on the Revised Draft of the EIR, SIR of April 1, 1982

The Revised Draft of the Environmental and Socioeconomic Impact Report of the Fare Increase on the MBTA contains some information – the Socioeconomic Impacts section, and the B and E sections of the Appendix – which was not included in the Preliminary Draft. The report uses unsubstantiated data and assumptions. This draft, like the Preliminary Draft, continues to make subjective assertions. We cannot accept technical analysis based on unclear data and assumptions.

The Environmental Impacts section is inadequate. Any qualitative analysis is impossible. The report does not specify the modeling procedures or the assumptions made. The model used for dispersion analysis is not adequately described. The algorithms and assumptions are not adequately described. Of special importance is the meteorological data including atmospheric stability conditions, and wind speed and direction data. The mixing height is not mentioned.

The contents of this Revised Draft could have, and should have, been prepared prior to the August 1981 fare increase, as required by MEPA. Responsible advance planning could have prevented the unnecessary ridership loss, which has resulted in unnecessary negative socioeconomic and environmental impacts.

- All data sources have now been provided. Where methods were adapted from some other work, this material has been cited.

- A separate dispersion analysis was not conducted. The information used for CO Hot Spot Analysis has been expanded and additional sources are provided. Lead analysis has been added. Total emission increases have been estimated using the MOBILE2 method and have been disaggregated only to the corridor level. Meteorological data is not used in a model of this sort.

CLF

April 21, 19

RECEIVED
APR 21 1982
OFFICE OF THE SECRETARY OF
ENVIRONMENTAL AFFAIRS

Executive Office of Environmental Affairs
100 Cambridge Street
20th Floor
Boston, Massachusetts 02108
ATTN: MEPA Unit

Re: Preliminary Draft Environmental and Socioeconomic Impact Report of the Fare Increase on the MBTA, EOEA No. 4147.

Gentlemen:

The Conservation Law Foundation of New England, Inc. ("CLF") appreciates this opportunity to comment on the Preliminary Draft Environmental and Socioeconomic Impact Report of the Fare Increase on the MBTA. As the attached comments explain in detail, CLF requests the Secretary to find that this preliminary draft EIR does not adequately comply with the requirement for a draft EIR under MEPA and to require issuance of an additional draft EIR which is substantially improved.

CLF received the revised draft EIR only yesterday, so no assessment of the added sections is included in these comments. Additional comments on the revised draft will be submitted later.

Please contact us if you have any questions on the comments which follow.

Sincerely,

Stephanie Pollack

Stephanie Pollack

Jeannie Nachimson

Jeannie Nachimson

SP/JN/abg

Enc.

Conservation Law Foundation of New England, Inc., 3 Joy Street, Boston, Massachusetts 02108 (617) 742-2540

1. INTRODUCTION

The Preliminary Draft Environmental and Socioeconomic Impact Report of the Fare Increase on the MBTA is replete with omissions, inaccuracies, biases, miscalculations, and ambiguities. The document contains little more than compilations of existing statistics and studies; even this data gathering is incomplete, and the amount of actual analysis in the report is negligible. The usefulness of this report as a draft of a final EIR is therefore seriously impaired. CLF requests that the Secretary of Environmental Affairs find that this preliminary draft EIR does not adequately comply with the requirements for a draft EIR under MEPA and require issuance of a second draft EIR incorporating responses to the following comments.

The numerous and significant concerns detailed in the comments clearly illustrate the preliminary nature of this preliminary draft. A second draft, substantially improving this version, is essential if the integrity of the draft review procedure is to be upheld. The purpose of a draft is to present a reasonably complete and reviewable report for public comment, but this document does not fulfill this condition. To allow it to serve as the only draft before the final EIR would be a betrayal of the whole reason behind having a draft in the first place. The next version of this preliminary draft will be radically different if it seriously addresses a significant percentage of the more than 70 specific comments which follow. Agencies and individuals will therefore be commenting on an essentially new document. This new document should be considered the draft EIR, in order to allow adequate opportunity for review of the analysis presented before the final EIR is issued. A second draft will also increase the likelihood of the final EIR being complete and useful as a planning document.

CLF's request for the Secretary to require issuance of a second draft EIR is further supported by the MBTA's failure to submit two crucial appendices on estimation of ridership until the end of the comment period. Much of the analysis in the preliminary report proceeds from an assumed drop in ridership which is explained in these missing appendices. The revised draft, received by CLF on April 20, is simply the preliminary draft with omitted sections added and does not fulfill the intentions of the second draft CLF has requested.

The final EIR should fulfill two functions. First, it should serve as a planning document for future proposed fare and service changes. Second, it should analyze the impacts of the past fare increases and service changes so as to define mitigating measures for these impacts. James O'Leary, General Manager of the MBTA, committed the MBTA to fulfill those functions in the EIR when he promised that the following would be part of the report:

> The EIR will be updated by the MBTA every time it raises its fares or makes a major reduction in service. The EIR shall develop the process for the updating, and the criteria for determining what constitutes a major reduction in service.

- A revised draft E.I.R. was issued in September 1982 and included this information as does this final report.

> The EIR will include an analysis of the 1980 MBTA fare increase both alone and together with the August 1, 1981 fare increase, as well as the March 1981 service cuts. (Memorandum from James O'Leary to John Bewick in the Certificate of the Secretary of EOEA regarding the System Wide Fare Increase, July 31, 1981)

This preliminary draft EIR does not develop the process for updating of the EIR, nor the criteria for determining what constitutes a major reduction in service. It does not include an analysis of the 1980 fare increase or the March 1981 service cuts. As the following comments specify, it is incomplete in many other ways. The MBTA can do a far better job of creating a document which fulfills the primary functions of this EIR. The Secretary of EOEA can mandate the creation of such a useful document by requiring a second draft EIR addressing the comments of CLF and others.

II. EXISTING CONDITIONS, RIDERSHIP, ALTERNATIVES, AND MITIGATING MEASURES

The comments which follow pertain to all sections of the preliminary draft other than Section 4.0, Environmental Impacts, which is considered separately later. All of the sections include the same types of errors: missing and incomplete information, bias, and an absence of original work or findings. These problems are detailed below.

- This analysis is discussed in several places in the report and is now included in Summary(Sec. 1)and in Elasticity Analysis in Section 3.

A. Information Not Available

A significant portion of this Preliminary Draft Environmental and Socioeconomic Impact Report was not submitted by the MBTA for review by interested parties until April 12, and CLF did not receive it until April 20, the day before the end of the comment period. The unavailability of this vital data, particularly the entire sections on Socioeconomic Impacts and Estimates of Ridership Loss, greatly hinders any complete review of this document. The accuracy and validity of much of the information that was submitted for comment depends on the validity of the unavailable information.

The information unavailable in the preliminary draft includes the following items:

1. Section 6 - Socioeconomic Impacts.
2. Appendix B - Problems with Estimating Ridership.
3. Appendix E - Estimates of Ridership Loss.
4. Table 2-7 - Cost per mile of operation in different cities.
5. Average cost/passenger in 1981 and 1982, page 27.
6. Glossary of terminology and jargon.
7. Summary.

The first five items are included in the revised draft dated April 1.

B. Incomplete Information

A good deal of the data and discussion presented in this preliminary draft report is incomplete. This incompleteness not

- All of these items were included in the September 1982 version of the draft.

only hinders review of the existing data and renders the report less useful as a planning document, but results in failure to fulfill the principal purpose of thoroughly and convincingly assessing the impacts of fare and service changes on the MBTA. The following material should be provided or revised:	
1. State the source and date of each table and figure.	• This has been done.
2. Provide a clear statement of policy or mandate of the MBTA (Section 2.1).	• See section on MBTA Management Policy in Appendix A - Section 1.
3. Provide a more detailed and useful description of the budget process and the responsibilities and authority of each main character in the process. The description should detail what the words "controls," "reviews," and "approves" entail on page 3.	• Now included in Appendix A - Section 2.
4. Clear and comprehensive information on schedules is essential.	• A summary of major service changes appears in Table 2-6 "Chronology of MBTA Service Levels and Fares."
a) Provide current service schedules and service schedules before and after each major service change since June 1980, including the 1981 first-quarter service reductions and any restoration of service occurring thereafter. This data, to be put in an appendix in a coherent format, should be readily available from the MBTA; its unavailability leaves an impression that service and decisionmaking at the MBTA is on an ad hoc basis.	• A summary of line statistics for all rail lines and each bus route has been included in Appendix C - Section 2. In addition, load factors, included in Appendix C-1, is representative of service levels provided.
The text of the report can then include a description of the major changes that have occurred in service. This	• See Table 2-6.

Page 6

document cannot serve as a basis for further changes unless this data is provided.	
b) Describe the overall policy of service. The "set of basic guidelines and methods for instituting service reductions" developed by the Office of Service Planning would be a helpful addition in an appendix.	• The MBTA Service Policy was used as the basis for service changes along with technical judgments based on data of ridership levels on each route. This process is detailed in Appendix A-5.
c) Table 2-1, MBTA Vehicle Assignments, is irrelevant without an accompanying schedule of runs. Moreover, the April 1, 1981 source date is outdated and confusing. How valid are those numbers today? Do they include 1981 first-quarter service cuts or not?	• See Appendix C-2 for schedule information. Also Tables 2-2 (A and B) have been revised Table 2-2A displays vehicles required before the service cuts and 2-2B after the cuts were made. Recent data may be found in a current issue of the MBTA Bus and Rapid Transit Service Reports.
d) The updated and relevant data from Appendix C on MBTA Load Factors should be extracted and presented in a clear, readable, and concise format which fulfills the Scope's intention.	• Dates have been added. The peak load table is presented in the format which is most useful for analyzing each route.
e) Table 2-11 in Appendix D, dated 1977, should be updated or omitted.	• It has been updated.
f) Verify or correct the following statement found on page 12: "The MBTA estimates that total service on buses is between 12% and 13% of that provided, in 1980."	• This has been corrected.
5. Describe in general the extensions under construction.	• They have been added in the text and in Figure 2-3.
6. CTPS states on page 25 that the 1980 and 1981 figures are not directly comparable to those prior to 1980. Yet the	

text of Section 2, Figures 2-5, 9A, 9B, and 10, and Tables 2-3 and 2-5, leave the clear impression not only that these figures are being directly compared, but that they are indicative of actual trends, even to the extent of having them on the same time line. If such use is to be made of noncomparable data, it is essential that an estimate of the degree and direction of noncomparability be made and the degree of confidence in that estimate be stated. In addition, any nonhomogeneity of data in a table or figure should be stated on the table or figure itself.	• Changes have made differences in data more obvious. • This has been done.
7. Describe how ridership counts were and are taken, and how often counts are scheduled (Table 2-3, Figure 2-6).	• See Appendix B and CTPS Technical Report No. 3 "1981 MBTA Fare-Mix Sampling Program: Analysis and Documentation" for more information.
8. The text states that Figure 2-6 displays boardings by station in November 1981 and notes changes from December 1980, but these changes are not apparent on Figure 2-6.	• Changes have been made in the text.
9. The word "cost" is used numerous times for different purposes in the report. Clarification of what costs are included is necessary each time the term is used.	• Section on Cost of MBTA Service has been revised to clarify this issue.
10. All cost figures on tables and figures would be more useful if shown, at a minimum, as real dollars, and preferably also in current dollars (Tables 2-6, 2-11, Figure 2-11).	• Real dollars have been added.
11. Indicate whether the range of elasticities presented on page 43 are arc or point.	• This has been corrected.
12. Discuss more thoroughly the quality of service effects on ridership. What were the changes in number of trips missed over the past two years (page 47)?	• This section has been expanded.

13. The Scope requires prediction and measurement of ridership losses due to 1980 and 1981 fare increases. In addition, James O'Leary guaranteed an analysis of 1980 service reductions.	
a) The effects of the 1980 fare increases and service reductions are sorely neglected in this report (Section 3.0).	• The 1980 fare increase has been included in the diversion models and the air quality impacts. The study of the effects of this fare increase have been combined with the 1981 increase.
b) CTPS states as a concluding sentence in Section 3.4 (Analysis of Ridership Loss) that "It appears that the combined effects of both fare increases on the rapid transit lines would explain the unexpectedly high ridership loss that resulted" (page 47). This conclusion needs further description and explanation as to how and why the riders' response to the combined fare increases was greater than the two increases considered independently and what this means for future increases.	• This statement merely reflected the fact that an elasticity analysis was not done for the 1980 increase separately. By the cumulative effect of the two increases, the total impact was greater.
c) The ridership loss (absolute numbers and percentage), disaggregated by bus, rapid transit, and combined trip, should be presented for service reductions and fare increases separately in Section 3.0.	• The elasticity figures, which were used to determine the effects of service reductions, are not available at this disaggregate level.
14. The aim of the text in Section 5.2 on Implemented Action is ambiguous. a) The amount of revenue expected to be and actually raised by the 1981 fare increase should be specified separately as it is obscured by the overall budget.	• This has been clarified in the text.

b) This section's focus on defining what, including service cuts, will have to be done because the budget is considered too low leaves an important question unanswered. Did the implemented action, controlled and defined by the MBTA, fail to meet its goals, creating the need for service cuts, or were the extensive service reductions always an inherent but hidden component of the implemented action? This relation between the 1981 fare increase and the service reductions must be further clarified.	• See Table 2-6. Service cuts were implemented prior to August 1981 in an attempt to avoid a fare increase by reducing expenses. When it became obvious that this strategy would not provide a balanced budget, a decision was made to increase fares. At that time, the MBTA committed itself to a gradual restoration of service.
15. The preliminary draft's discussion of peak period pricing is inadequate. a) State the original fares on lines reduced to 10 cents. By only stating that the Quincy Line dropped from 50 cents to 25 cents, it leaves the impression that all other lines went from 50 cents to 10 cents on dime time.	• Has been clarified.
b) Explain why Decision Research Inc. was unable to quantify any gain in ridership through reduced off-peak fares (Dime Time) but the MBTA was recently able to quantify a substantial gain in ridership by reduced off-peak fares for the elderly.	• Explained in more detail in Section 5.3.1.
c) Detail, with data and methodology, how the actual response of elderly to the new free off-peak fares was measured.	• See Section 6.2.2, Section on the elderly.

16. An estimate of confidence in the figures and conclusions shown on Table 5-1, Effects of Alternative Fare Structures - Summary, is necessary.

17. Section 7.0, Mitigating Measures, is of vital importance to this document and to MBTA planning. Mass. Gen. Laws ch. 30, § 61 requires that all feasible means and measures be used to avoid or minimize damage to the environment. James O'Leary guaranteed in the July 31, 1981 Mitigation Packet that "The mitigating and policy alternatives that are required to be identified by the MBTA will be binding upon the MBTA, unless the MBTA can show by 'clear and convincing evidence' why it has rejected those measures." This section summarily dismisses the effectiveness or practicality of mitigating measures. The binding nature of the mitigating measures might explain why they were preemptorily dismissed by the MBTA; nevertheless, this section will not be adequate until some effective and practical mitigating measures are defined.

a) This section is incomplete without defining the time schedules and preconditions for the efforts described to improve operating efficiency through the application of management rights and modern technology. For example, when will "The Authority, after full installation and implementation, have the means to accurately count all passengers and the ability to provide accurate information for

- Factors that cannot be quantified, such as "ease of implementation," were rated on an ordinal scale. A high level of uncertainty (± 50 percent) is associated with these rankings. The actual values listed in this table are approximations based on observations in other systems. Their purpose is to offer a basis for comparing the results of various fare structure programs.

- This is now included in detail and with schedules for implementation in Section 7.0.

scheduling, safety and security" (page 96)? What are the preconditions?

b) Section 7.1.3, Service Restoration, should include a description of to what extent the service restorations, outlined in the July 31 Mitigation Packet, were completed.

c) Section 7.2, Legislative Programs, should describe what steps have been taken toward having the relevant state agencies shoulder the subsidy payments now shouldered by the MBTA.

18. Appendix A, Summary of Studies to Improve the MBTA, should include a list of the title, date and chief author/instigator of each report written in 1970-81 to improve the MBTA.

C. Biases

This preliminary draft report includes a significant number of words, phrases, and assumptions which are not appropriate in an objective and useful planning document. The author should be careful to separate facts from MBTA rationalizations in writing this report and to guard against utilizing the convenient MBTA position as the only or final position. The author should strive to not create possibly incorrect impressions through the unqualified use of unanalyzed MBTA assumptions. The MBTA's rationale for actions can be included but only if MBTA sponsorship is credited clearly; the rationale should not be described as having a cause-effect relationship to the MBTA action.

- This is detailed in Section 7, Mitigating Measures.

- Information on Legislative proposals is available in Appendix A-7 and is expanded in Section 7.

- A listing of studies on the MBTA is included in Appendix A.

Page 12

The following five quotes provide some examples of the pervasiveness of the bias in the Report. Although it would be an immense improvement if the author thoroughly edited out all such biased language in the actual writing of the report, the greater damage to the use of this report as an objective planning document lies in basic assumptions and analysis and not just the written word. These unfortunately cannot be edited, and can be traced to the close relationship between the MBTA and the author. The biased language is simply a symptom of a far deeper bias.

The following statements, with emphasis added, illustrate the use of unsupported, subjective, deterministic and/or irrelevant language in this report.

1. "The MBTA has been forced to reduce service in an effort to alleviate financial problems." (page 10)
2. "Only 21% of the funding for the MBTA is generated by the fare box revenue." (page 27)
3. "The best estimate of what would have happened . . . if a fare increase had not been implemented is probably the MBTA's own estimate presented in the ENF." (page 60)
4. "Additional service cuts are expected in 1982 due to an approved budget level lower than proposed by the MBTA." (page 12)
5. "It is likely that increased fare box revenue would

- Has been changed.
- Has been changed.
- Has been changed.
- The federal Section 5 operating assistance is scheduled to be phased out over the next three years. In order to maintain the current level of service, additional funding must be generated from existing or potential sources. This is also changed in the text.

be put towards making up this difference (in loss of federal funds). (page 34)

D. Absence of Comprehensive, Original Work or Findings

The incompleteness and bias of the material in this report is compounded further by the general lack of continuity and sparseness of analysis and interpretation of data, facts, and trends.

The report could be described at this preliminary stage as being an accumulation of facts, trends, data, and oft-heard MBTA positions. The major continuity in this accumulation is its use to bolster the status quo of MBTA procedures. Yet MEPA states that "An EIR should not be used to justify or support a decision that has already been made."

Data on gasoline prices, efficiency changes, trends in cost per passenger and per mile, MBTA costs per mile vs. those of other cities, load factors, number of buses, and similar other details are gathered, but seldom are independent interpretations made or links between data drawn or analyzed.

III. ENVIRONMENTAL IMPACTS

The discussion of air quality impacts of the ridership loss is seriously deficient. Unless this section is significantly rewritten and recalculated, the final environmental impact report will contain almost no analysis of environmental impacts. The current presentation is so incomplete that no comments can be

- Corrected in text.

made on the magnitude, importance, or mitigation of air quality impacts. A particularly severe problem is that all of the analysis is based on a fixed estimate of ridership loss which, as noted above, has not yet been justified. Subsequent reports should at least roughly recalculate impacts for higher and lower ridership loss estimates.

A. Incomplete Information

The environmental impact section of the preliminary draft EIR essentially summarizes the descriptions and calculations in Appendix F, which is itself incomplete. The first few items noted below must be included in the EIR to put the discussion of air quality impacts into context by describing the existing environment and regulatory system. The remaining omissions must be corrected in order to allow interested third parties to replicate the MBTA's calculations if they so desire. For the carbon monoxide hot spot analysis, which may be too complicated to reproduce, appropriate listings of assumptions, worksheets, and/or sample calculations should be presented.

The following information was not included in the preliminary draft:

1. No data is given on historical, current, and projected ambient levels of hydrocarbons (HC), carbon monoxide (CO), and nitrogen oxides (NOx) in the region of interest.

2. No data is given on emission of these pollutants by both mobile and stationary sources in the region of interest.

- The text has been expanded slightly. However, for an example of the CO Hot Spot worksheet used, see Tables 3-2, 3-3, 3-4 in the CTPS report "Identifying CO Hot Spots," July 1981.
- See Section 4.2.5. and the new Appendix F-1. For further detail, see the Mass. 1982 State Implementation Plan for Ozone and Carbon Monoxide, Chapter 2.
- See Appendix F-1.

3. No information on ambient levels of other criteria pollutants is given although such data is pertinent for later consideration of synergistic health effects.

4. No description of the appropriate portions of the Transportation Element of the State Implementation Plan (TESIP), including the requirement for Reasonable Further Progress (RFP), is given.

5. No listing of pertinent state and federal air quality standards and guidelines is given.

6. No background data is given on trip purposes, trip lengths, and automobile ownership used to assign diverted trips to alternate transportation modes (p. F-1).

7. Only incomplete data is presented on average trip lengths for all areas of origin, for students vs. other tripmakers, and for core vs. other destinations (p. F-4).

8. No listing of emissions factors used to convert VMT into emissions in tons/year is given, either in the form of individual factors at given speeds or appropriated weighted averages for different types of trip (p. F-13).

9. No emissions factors or adjustments were given for different vehicle operating modes (p. F-13).

10. No worksheets, analagous to those given in the queueing calculation, were included for the VMT and emissions calculation.

11. No quantitative assumptions or calculations were presented in the description of the CO hot spot analysis (p. F-14).

- See Appendix F-1. Ambient levels are not given for lead. These have not been uniformly monitored in the state.

- Now contained in Chapter 4.2.5 .

- See Appendix F-1 and U. S. EPA/DOT "Transportation Planning Guidelines," 1978, as amended. These guidelines were incorporated into the state's 3C planning process, as described in Chapter 4 of the 1983 TE/SIP.

- Background information came from the sources listed in Appendix F-2.

- See Appendix F-2 for a summary of trip length assumptions.

- A-8: A sample of the MOBILE II emission factors have been placed in Appendix F-6. These values include various combinations of temperature, speed, and cold/hot/hot stabilized operating procedure.

- A-9: The air quality analysis was not carried out at this level of detail. Emission rates associated with differing vehicle operating modes have been incorporated into the Mobile II factors.

- The text has been expanded slightly. However, for an example of the CO Hot Spot worksheet used, see Tables 3-2, 3-3, 3-4 in the CTPS report "Identifying CO Hot Spots" July 1981.

12. No conversion of increased emissions to increased ambient levels was performed.

B. Poorly Explained Methodology and Assumptions

Providing all the information listed above would still not allow an interested third party to reproduce the MBTA's analysis. The preliminary draft gives an incomplete description of the methodology used to calculate air quality impacts. Given the uncertainty surrounding some of the most important inputs - such as ridership loss - this methodology is a more important planning tool than its quantitative outputs. The uncertainty about some of the assumptions also dictates that each assumption used in the analysis be documented and justified:

1. What is the justification for skewing trip allocations toward downtown and core trips? Was any empirical evidence used in making the assumption that a higher percentage of short trips will be made?

2. How was percent of total trips converted into percent of lost trips? (Table F-1) Apparently the percent of downtown trips was doubled and the percent of core trips was held constant. If this was done, how were the remaining trips allocated?

3. What is the basis for the assumptions about diversions to other modes? (Table F-2) Were these figures calculated or estimated?

4. The data at the top of the fourth page of Appendix F cannot be calculated simply by applying the factors in Table 2

- A-12: A substantial modeling effort, involving the Transportation Air Shed Simulation Model (TASSIM), would be required for this conversion. This computerized model is capable of simulating concentrations of five primary pollutants resulting from mobile and stationary sources. Such a modeling effort would require extensive staff time and was considered an unnecessary level of detail for this report.

- B-1: The demand for short transit trips appears to be more elastic than is the demand for long trips with respect to fare. The London Transport Review Board's 1968 mathematical analysis shows that bus trips of less than one mile exhibit higher elasticities (-.55) than trips of 1-3 miles (-.29). In Essen, Germany, fare elasticities for short- and long-distance trips were found to be -.32 and -.12, respectively. Source: Transportation Research Board, "Transit Fare Policies," p. 44-45.

- B-2: Two assumptions were made in converting the total trip percentage distribution to the lost trip percentage distribution. First, that the lost trip distribution would be skewed toward the downtown and core areas, due to the difference between long- and short-distance fare elasticities. Second, that the percentages of lost trips for the surrounding corridors would be reduced by a constant factor to compensate for the shift in trip distribution.

- B-3: Diverted trips for each corridor were assigned to competing modes or combinations based on relative accessibility, time, and cost. The distribution among modes is the result of professional judgment based on data for existing commuter rail and private bus service, auto ownership, trip purpose, and trip length.

- Corrections have been made to this table.

to the trips in Table 1. When and how was rounding performed? Obvious errors, such as the number of core taxi trips, should be corrected.

5. How was the calculation of VMT adjusted to account for students? How were home-based work trip lengths adjusted to account for core and downtown trip lengths?

6. How were core trips allocated among cities in the calculation of assigned automobile routes? (p. F-8)

7. Why is there a discrepancy between the number of trips from each area of origin at the top of the fourth page of Appendix F and the number allocated in section F-3, Table 1?

8. What is the basis for the assumptions about diverting cars from Storrow Drive and the Southeast Expressway? (p. F-8)

9. What is AWDT and how is it calculated?

10. A more explicit and quantitative description of the methodology used in the CO hot spot analysis should be presented.

11. Give the source, year, and justification for selecting the following data assumptions:

a) Automobile occupancies of 2.3 and 1.6 for peak and off-peak (p. F-4)

b) Hourly highway capacities (p. F-9)

c) Base case traffic volumes (p. F-9)

d) Background CO concentration of 3.0 ppm (p. F-14)

C. Absence of Conclusions and Mitigation Measures

The preliminary draft EIR makes no attempt to interpret

- B-5: 15 percent of all diverted trips were classified as children/student trips. The VMT for these trips were calculated separately using an average trip length of 3 miles.
- See Appendix F-2 for table on distribution.
- B-7: The auto trips from each corridor are not simply person trips divided by two. This is because three sets of ridership loss estimates had been presented over the course of analysis and rounding error arose from adjusting each time. In any case, the estimates of trips diverted is higher and so a worst-case scenario is presented.
- Assumed that diversions would behave similarly to current conditions.
- B-9: Average Weekday Traffic Volume; data used was from the Queuing Analysis in the Central Artery O/D Study, CTPS, 1977.
- Has been included in greater detail.
- The estimate was used in " An Analysis of R.A.C.M.'s to improve Air Quality", C.T.P.S., July 1981 and itself came from a series of E.O.T.C. Memoranda on Ride-sharing.
- Derived from TRB Circular No. 212, "Interim Materials on Highway Capacity."
- AWDT came from the 1977 Central Artery O/D Study, CTPS.
- DEQE furnished this information.

the results of the air quality analysis or to relate the calculated increases to implementation of the TESIP. The document contains no discussion of the health and environmental impacts of the increased emissions nor does it seriously assess air pollution mitigation schemes. In short, the preliminary draft does not carry the environmental impact analysis to any useful conclusion.	
The following changes and additions must be made to correct these inadequacies:	
1. Summarize current information on the health and welfare effects of the three pollutants of concern.	• C-1: The determination of health effects was not included in the work scope. The EIR analysis was concerned with the effect of additional emissions on Boston's attainment of the Clean Air Act standards. The "Backgrounder on the Clean Air Act" by the House Wednesday Group provides a description of the policy framework and standards of the Clean Air Act. These standards were developed based on the health effect of air pollution. A survey of some of these studies is included in "The Health Costs of Air Pollution" by the American Lung Association, 1977, pp. 73-92.
2. Discuss possible synergistic effects of the three pollutants acting together and in combination with other criteria air pollutants.	• This was beyond the work scope.
3. Explain the MBTA's role in implementing the Boston area public transit portion of the TESIP.	• See the current TE/SIP, Chapter 5.
4. What impact will the three predicted CO violations have on the achievement of Reasonable Further Progress in bringing Boston into attainment?	• Included in Section 4.
5. How were VMT and HC emissions calculated from the fare structure alternatives in Table 5-1?	• See Section 5.3.6.
6. Discuss air pollution mitigation measures which will offset significant percentages of the projected emissions increases. Alternatives should not be restricted to those which the MBTA can implement.	• This is beyond the scope of work.

Draft Environmental and Socioeconomic Impact Report
of the Fare Increase on the MBTA
EOEA #4147
Member of the Study Review Committee - April 21, 1982
General Comments on the Draft by Clark Frazier

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The document needs a stated policy. If policy has been ennuciated in other certification documents, it should be included and referred to throughout this document. For example, would the policy suggest that decreasing VMT is a goal? There is not the sense that permanently declining ridership is bad. This document also needs an overall policy framework. There is no particular reference to stated growth policy objectives which include focusing economic growth in existing business/commerical areas. Instead, the report assures a continuing downward spiral; dispersion of population and business (without much growth) continuing decline in T ridership & service. Simply stated; the actions that the EIR is reviewing would cause the effects listed under "assumptions". On the other hand, the City of Boston is projecting a 30% growth in downtown square footage. No similiar increases to the road system or parking are projected. In fact, commercial parking is "frozen: at 1975 levels.

Redevelopment and now population growth of downtown neighborhoods is occurring. The rapid rise in real estate values and the very high cost of land and new housing is now forcing population growth "inward" to reclaim existing housing. Past trends of abandonment and disperial are probably at an end. A pattern of concentration at "suburban nodes" is now occuring with attendant traffic congestion.

- The policy section has been rewritten. Specifically regarding VMT, the goal is to minimize the regional trend of rising VMT; references to increasing VMT describe past and present trends.

- A policy framework has been added to the report in the Introduction Section 1.1.1 and Appendix A and includes statements on economic growth.

- The assumption with regard to ridership levels was that current levels would remain constant (if there were no changes in service provided or major changes such as the price of gasoline).

- Background assumptions about population distribution are based on the Metropolitan Planning Council's forecasts of population and employment. These forecasts support the contention that the City of Boston will experience employment growth and population stabilization in the coming years.

Why is the T investing in extensions if decline is expected?

A reference was made to the State Implementation Plan (SIP) still being "under revision". Clearly, a major reduction in VMT (and a major increase in transit use or a decrease in trips must occur if clean air objectives are to be met (exclusive automobile users travel 10 times as many mileage per year as exclusive transit users).

A person making a permanent mode switch from transit will increase VMT disproportionately to transit.

This study examines changes resulting from this action (which will be small in the short term) but fails to make the connection that the cumulative effect of many of these "small" actions have caused the current state of affairs to be reached. That is, a 50% drop in transit use in 20 years; a major increase in highway use (and cost). Extensions of service just to retain part of a more dispersed ridership. Decline of weakened transit oriented neighborhoods.

The fare alternative (see detailed comments) are biased and misleading analyses based on the underlying assumptions (which are not stated anywhere) that any rider oriented fare system would be "too hard to administer". Also ignored consistently are operating cost savings that various fare options could produce.

The last problem is that the various mitigating programs listed were mostly "under consideration" or "proposed" or "under development" with not particular sense of deadlines or projected completion dates.

The Ⓣ is of strategic importance to the City of Boston and to the Region and State economy as a result. This report should suggest

- Through system extensions, the MBTA looks to increase its service area and be able to draw from a larger market, thus increasing ridership and addressing the congestion problems at suburban node points.

- According to the 1983 update of the SIP and the Transportation Element of the SIP, with the implementation of those Reasonably Available Control Measures (RACMs) likely to be carried out, the region will be in compliance with the 1987 air quality standards. Additional reductions beyond those required by the Clean Air Act will provide an economic growth cushion for the region. The projected additional VMT of .5 percent resulting from the fare increase will have an effect on this cushion.

- The purpose of the EIR was to look particularly at this one action and not the collective effects of other events, which have occurred unrelated to fare changes.

- This section (Chapter 5 Section 3) has been revised.

- Chapter on Mitigating Measures has been rewritten and their status has been clarified. The MBTA has provided specific information on its level of commitment to a variety of projects.

ways that the political or administrative process could respond to to the needs raised in the report and develop programs that would adhere to existing goals rather than undermine them. If the fare increase and its effect action is consistent with current policy then those policies should be articulated and documented for all to see.	• See the new sections on MBTA policy in the Introduction and in Appendix A.

Detailed Comments on the Draft EIR - April 21, 1982	
(2.4) Ridership Trends and (2.5) Fare levels on the MBTA A large drop in ridership occurred when the free transfer was abolished. The Ⓣ fare structure appears to minimize both ridership and revenue. p. 13, p. 20, Table 2-5	• This is true.
"1977 Transit Market Study" April, 1977 was produced by EOTC and CTPS p. 16 Two cases exist: 1) concessionary fares for elderly, handicapped, students; 2) The pass program designed to reduce fare collection costs and increase off peak ridership. p. 25	• Studies of fare structures among transit properties indicate that, although it might be somewhat modified, the MBTA maintains a common type of fare structure. In other properties studied, fare increases nearly always brought about revenue increases. However, ridership is found to be more sensitive to changes in service than to changes in fare.
2.6 Cost of MBTA Service Ⓣ costs have risen faster than inflation. What are the cost components? What is the % funding by fares after the increase? p. 27	• This report contains a breakdown of the actual MBTA costs for 1978 through 1981, as well as projected figures for 1982.
Section 3.0 Ridership Impact of Recent Fare Increases 1. The impact is difficult to measure because of built in inequities to the present fare structure. 2. Lack of a free transfer forces the single ride fare to be somewhat too low and the combination fare to be too high. In effect combination riders (who must also change vehicles) are discouraged by high fares and single mode riders often pay less than the fare would be if free transfers were issued. Thus ridership and revenue are both minimized. 3. Riders may change destinations; particularly for shopping. This hurts downtown Boston and Back Bay .	• See the section on Transfer Policy 5.3.4.

4. The reason that linked trips show the "same" elasticity as unlinked trips is that linked trip data is derived from unlinked trip data. p. 45	• Linked trip data was created from unlinked trip data by applying factors developed during the Wilbur-Smith (1978) Ridership Survey. This is the most recent source of information and its results were used to derive linked trips.
4.0 Environmental Impacts The assumption that trips can switch mode is questionable. Downtown street capacity is limited. Therefore a decrease in MBTA ridership both diverts trips away from downtown (generally increasing trip length) or additionally increases congestion of downtown streets (if that is possible). The expressway and street system in and near downtown are already at capacity. A few additional vehicles will increase delay times disproportionally for everyone.	• An assumption was made that a portion of transit trips could, in fact, divert to automobile travel. This is evident during unusual situations, i.e., strike days that some additional modal switching is possible, though undesirable.
This additional delay time needs to be quantified.	• See Appendix F-2 Queuing Analysis has been conducted to study this phenomenon.
The seriousness of the CO problem is underestimated. There is no justification for making a situation worse because it is bad already. pgs. 56-57	• Section 4.2.3 Carbon Monoxide Increases: Intersection Impacts has been rewritten.
The assumption that trips diverted from transit will stay the same length is false. Divirted trips to other destination may be longer. Therefore the increased VMT is underestimated.	• No assumption that diverted trips maintain the same trip length has occurred. Independent trip lengths were developed based on those cited in the TE/SIP.
5.0 Alternatives 5.1 The MBTA could have cut administrative overhead and other unnecessary supervisory persons before cutting service but chose not to. pgs. 60, 62	• See Management Practices Study, Section II: Evaluation of Staff and Budget Levels and Appendix A: Comparison of Staffing and Expenditure Levels and the Organizational Structure of Four Departments with Other Systems.
The costs that the Ⓣ incurs need to be summarized into a few categories and quantified.	• This information is available in the MBTA Budget 1983/FY 1984, page 14.
5.2 Peak Period Pricing The point of peak period pricing is to reduce costs by reducing the peak equipment and manpower requirements. This may increase the peak highway capacity needs, however.	• For particularly that reason, it is thought that the negative effects of peak-period pricing would outweigh the benefits.

5.3.3 Self Service Fare Collection

This section was written from a very negative point of view. Not all of the major benefits are listed. The additional major benefits are reduced cost and improved accessibility (all station entrances can remain open). Security can be improved because the station attendant can walk around through all parts of the station.

The negatives mentioned:

1. Vandalism - also shared by automated systems such as BART, WAMTA

2. High labor cost of ticket selling - this is the current problem with tokens.

3. The idea that Boston residents are not law abiding because of a 15% collection ration on parking tickets should be attributed instead to poor administration.

4. Page 77 - "reduced construction costs of little interest". Extensions are underway where lack of barriers could noticably decrease costs....

Also, 20% of capitol costs end up as "fixed costs". (The state share)

5. A major means of avoiding various fare collection problems is to sell passes to the majority of riders. A self service system does not require pass readers and other barrier equipment. Instead a system of passes (with photo) and validation stickers or stamps can be used.

This and other sections fail to detail what cost savings and other benefits could occur.

5.3.4 Transfers

The current system minimizes ridership and revenue. Single ride fares are artificially low so that the combination fare will not

- Changes have occurred in this section, and improvements suggested have been largely incorporated.

- See Section 5.4.3. for a discussion of self service collection procedures.

be too high. But the combination fare is always perceived to be too high. The current fare policty exists because no one worries about any issues larger than making it through the current bugetary year. The MTA used to use paid busway zones (like Toronto) to eliminate paper at high volume points .

5.3.5 Lower Fares for Downtown Distribution

An alternative not considered would be an all day pass prices at about 2½ full fares or alternatively a lower price pass 1½ fares good only for entry at downtown stations.

Another alternative is a transfer with 2 hour validity (San Francisco has moved to this system). This provides a 50% discount for round trips that can be completed within 2 hours.

The real problem with any type of downtown shuttle system in Boston is the street system.

7.0 Mitigating Measures

This section mainly discusses programs that, if implemented, could help speed service or improve productivity. The problem seems to be there are future plans and continue to remain that way. Signal priority has been discussed for years, using overly sophisticated technology, with the result that very little has been accomplished. The T has not digiligently persued such improvements as signal priority.

Comments from Ann Hershfang Boston-League of Women Voters to Debby Schreiber (and Sam Myggatt, if appropriate) Section 5:3.1 .. (p67) Impact of .... Elderly.. could this be in a chart so that the various ridership figures - 59,000 45,000 27,000 32,000	• Now in Section 5.3.2.
and ~~sor~~ revenues + savings could be easily correlated + understood? Also are these figures based only on "weekdays"? How many days a year?	• The assumptions are explained in Appendix B (base data) and Appendix E (ridership loss estimates) and a revised Section 5.3.1.
(p68) seems to change to another subject in ¶ 2 - and needs a new heading.	• Has been corrected.
5.3.2 (p71) Reduced fare ... Groups. ~~Also~~ The student fare discussion here is about raising not reducing them. The Boston LWV requested that you include an analysis of the possibility of + consequences of providing 1/2 fare rides for children up to 18 at all times, not just school hours. We again request it.	• Now in Section 5.3.2.

Exhibit 6: Are these figures available all day, not just peak period? (just curiosity.)

pp S2-3 – the Arborway line is missing

comparative Nov 80 & Nov 81

The League asked for garage use figures as maintained by various garages and traffic data for major radial highways, could w as an actual way of determining whether tr. automobile use into the region had increased, May those be included?

- See the listed source for additional time period information.
- This has been included where the data was available.
- Garage data is available in Section 2.
- This material has been included where possible in Appendix F-10.

Comments on the Final Environmental & Socioeconomic Impact Report of the MBTA Fare Increase.

League of Women Voters of Massachusetts
Contact: Anne Fanton, 263-4989

Introduction:	
There are substantial additions and improvements to the Revised Draft which are very useful, specifically: the addition of an Overview and a Policy Framework, and improvements to the sections on Service Level Changes, Ridership Impacts, Alternatives and Data Collection. The inclusion of the Scope of Work, Comments received by EOEA on the draft reports, a glossary, bibliography and index also greatly improve the impact report. CTPS responses to comments, noted to the right of each committee comment, were especially useful.	
Of great concern, however, is the omission of the comments by the Sierra Club and the Conservation Law Foundation (CLF), both of which contained detailed, thoughful recommendations for improving the entire draft report but most specifically the Environmental Impact section (4). Their comments were submitted to EOEA on April 21, 1982. Since apparently CTPS did not have these comments when preparing the final report, there is no response to them, nor any improvement to Section 4, with the exception of adding Section 4.2.4, Atmospheric Lead Level Impacts, as requested by EOEA. The League believes that the concerns of the Sierra Club and CLF have not been adequately addressed in the final report. We ask that you read their comments again and consider, for example, whether the environmental impact analysis is carried to any useful conclusion. In some instances, they may be asking for analyses that go beyond the Scope of Work, and that should have been called for at that time, but they do express well our shared concern that the EIR/SEIR breaks little new ground, and does not go far enough to be useful to future decision-makers considering fare increases and service reductions.	• These have been added and response to comments included.
Detailed Comments:	
1.) It was my understanding (AF) that Section VI (MBTA Expectations) of the Scope of Work would draw together the various sections of the report into final conclusions and recommendations. It stands instead as an isolated statement of existing MBTA policy. Whether this was just a misunderstanding during Study Review Committee discussions regarding the Scope of Work is probably not worth pursuing, but somewhere, probably at the beginning of the report, a summary of findings, conclusions and recommendations for each section and the report as a whole is very necessary if it is to be useful, especially since most readers will read just the summary. Also, thereason that so many committee members requested a policy framework was so that recommendations would aim to carry out stated policy. This has not been done.	• The MBTA policy framework is now summarized in Section 1 and explained in more detail in Appendix A. Also included is a summary of relevant portions of the regional transportation policy.
2.) 1.1 Overview, p.1 The League recommends that this section be expanded as described above, that it include a summary of Section 5, Alternatives and more detail on Socioeconomic Impacts and Mitigating Measures. The summary of mitigating measures (p.5) implies that the MBTA is already taking the necessary steps to mitigate the impacts of fare increases and service reductions. In fact,	• This has been done. The Summary section now includes this other information in a table form. Section 7 contains schedules for mitigating measures.

there are several recommendations for further action, on pp. 119-128, which should be highlighted in the Overview. We feel that the Overview should highlight all important conclusions of each section and state the recommendations.

3.) 2.4.1, Recent Service Level Changes, p.27
This section is much improved. 2.7.2 still lacks independent conclusions necessary to making this entire analysis useful.

4.) 3.0, Ridership Impacts, p.55
The addition of information on other cities is excellent and the entire section has been clarified. In the Overview, section 3.0 should emphasize above all the need for an accurate method of counting riders.

5.) 5.0 Alternatives, p.77
The League feels this section will be very useful to the MBTA as a first step towards a creative, equitable fare structure. Its highlights should definitely be included in the Overview section.

6.) 6.0 Socioeconomic Impacts, p.95
Also useful as a first step; it still lacks a clear recommendation for improving the MBTA's data collection. Where is the "MBTA technical memo"? (see p.164.)

7.) 7.0 Mitigating Measures, p.119
The major mitigating measures, promised by the MBTA in return for the fare increase (ref. EOEA #4147), were service quality improvements and service restoration. There is not enough attention given to service quality improvements (7.1.1) to know whether any came as a result of the fare increase.

8.) 7.1.3 Data Collection, p.121
This section is much improved, as is 7.2.2, Alternative Funding Sources.

The League would like to express its appreciation to Sonia Weinstock of CTPS for many of the improvements mentioned. We hope that the MBTA and EOEA will agree to revise the Overview, as requested, before Secretary John Bewick accepts the final report.

* * * * * * * * * * *

- The summary has been adjusted to address these points.
- This is stressed in several places in the revised draft.
- They have been included in the detailed summary.
- The memo referred to is CTPS Technical Report No. 39,"1981 MBTA Fare-Mix Sampling Program: Analysis and Documentation," which contains details of the data collection effort.
- Service quality improvements which were established as mitigating measure of the fare increase, can be found in Section 7.

mapc

METROPOLITAN AREA
PLANNING COUNCIL

110 TREMONT ST.
BOSTON, MA 02108
Tel. (617) 451-2770

April 23, 1982

The Honorable John A. Bewick, Secretary
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

Attention: MEPA Unit

RE: Draft Environmental and Socioeconomic Impact Report--Fare Increase on the MBTA, EOEA #4147 (MAPC #EIR-82-15, Received March 23, 1982)

Dear Secretary Bewick:

In accordance with the provisions of Chapter 30, Section 62 of the Massachusetts General Laws, the Metropolitan Area Planning Council has reviewed the above-referenced Draft Environmental and Socioeconomic Impact Report.

The MAPC staff has participated in the Fare Study Review Committee activities concerning this Environmental and Socioeconomic Impact Report and the MBTA Management Practices Study. Because of the size of the draft EIR and the cost of reproducing and mailing it, MAPC staff developed a four-page summary which was distributed to the 101 MAPC communities which include all 79 MBTA member cities and towns. The covering letter to the summary invited individuals into the MAPC offices to review the complete document if they wished or to contact MAPC staff. A total of 33 communities replied to the summary. The following is a summary of their comments.

- Lexington supports a well managed transportation system as a way to meet environmental concerns and provide transportation in an economical way to all concerned. We support a capping of MBTA assessments to municipalities.

- Would hope that reduced fares will not reduce service.

- Use of "citizen groups" to increase ridership. Do not close stations after 7 p.m. or on Sundays. We are living with the fare increase so it doesn't seem much can be gained with a decreased fare. Environmental impact discussed earlier at J.R.T.C. and I feel there is an adverse effect with increased automobiles in city. Cohasset does not directly have MBTA service and the community would like.

- I strongly oppose a fare increase on the basis of environmental and budget concerns.

Elizabeth A. Bransfield, president William C. Sawyer, vice-president Richard M. Doherty, secretary Patricia A. Brady, treasurer

Executive Director Donald E. Megathlin jr.

- The MBTA appears to be addressing their current problems as intelligently as possible. However, consideration should be given to lowering the fares and the parking lot charges, especially at Riverside, in an attempt to regain riders.

- Any increase in fares' effect on air quality or vehicular congestion is speculative and questionable. There is reason to believe, that lost ridership simply reduces total travel. Full fare paying potential users don't require 100% reliability; what they require is comfort. Diddling with the system is counter productive, an aggressive implementation of Chapter 581 is needed for this featherbedded-ridden system.

- Emphasis should be placed on improvements in operating efficiency and reduction of costs rather than increases in fares.

- Bus service for local and regional public and private schools should be abolished. The decision to grant free passes to the elderly should be revoked. Lines which do not provide an adequate cost/revenue relationship should be identified. *Then*, the fare decrease should be implemented. This study is flawed because it has allowed the (T) Board to move in directions which seem to be politically based.

- Some new items to consider: (1) threat of new and reduced restrictions in relation to car emissions to be instituted on federal level; (2) the impact of the recent and strictly-enforced parking regulations in Boston; and (3) what will be the impact of the newly voted fare decrease.

- It is patently unfair to base reduced rider T-fares on increased appropriation from the cities and towns. The citizens of Hanover pay 100% of their own transportation costs. Cutting the fares adds to the burden upon them.

- Need more detailed info on ridership by mode, bus, LRV, rapid transit.

- Are public hearings on this proposal be to held? When? Very concerned over proposed cuts in service, particularly in commuter rail (Page 3, Implemented Action), being included with a fare increase. What is the intent? How do the new "management rights" provisions affect fiscal operations (i.e., fares, reduced service, needed maintenance, etc.).

- The Town of Hamilton is not in favor of further fare increases.

- None of the above. Cutting service is *insanity*.

- There is no problem with the report but we question the impact of the increase in light of the proposed decrease for the (T). An impact study should be done.

The MAPC staff has previously expressed its concern for the impact of fare changes required as a result of the agreement between General Manager O'Leary and Secretary Bewick. It is highly likely that fare reductions will increase deficits and therefore require increased public funding or reductions in service.

In addition there is a concern that the MBTA has not been collecting sufficient ridership data by mode and route, along with other related data which can be used in analyzing the system. Data, such as level of service by mode and route and ridership by the mode, routes and time of day are not related to other factors such as operating costs and dependability. However the MAPC understands that the MBTA is in the process of improving their data collection procedures.

Very truly yours,

Donald E. Megathlin, Jr.
Executive Director

cc: Mr. Richard Easler, Chairman
Transportation TAC
Mr. Rocco Mancini
Massachusetts Bay Transportation Authority

APPENDIX A-5

SERVICE PLANNING: DESCRIPTION AND DATA BASES

SERVICE EVALUATION

This section presents the general framework within which the MBTA makes decisions for service changes based upon the service policy for surface transportation and the existing MBTA data base. This set of information is used by the Service Planning section to draw upon for implementing service changes, as explained below.

1. Description

Service planning has been the responsibility of the Service Planning section within the Operations Directorate. The Service Planning office is the major actor in implementing service changes consistent with the Service Policy. The Operations Planning and Schedules departments are also under the Operations Directorate and they are involved in the service assessment process. The process takes place on three levels as described below.

a. Route Configuration

The focal unit of service planning for introducing changes to the structure of routes--new routes, route extensions, route deviations, thru-routings, major changes in headways and hours of service--is the Service Committee, chaired by the Manager of Service Planning. Other members of the committee include representatives of:

- Service Planning
- Operations Planning
- Schedules
- Transportation
- Community Affairs and Marketing

In addition, there are several non-voting members who attend meetings as appropriate to agenda items. The managers of the Transportation division also have a strong influence on the decision of the Director of Operations.

b. Level of Service

The process explained above usually is initiated upon request from sources outside the MBTA for major changes in level of service; however, emergency conditions may require service changes initiated by the MBTA itself. The procedure of making minor adjustments to headways, trip times, numbers of scheduled trips, or responding to most internal requests for changes is handled more simply by the Service Planning or Scheduling sections. They rely on peak-load point counts and on-board characteristics counts, in order to study the recommended adjustment. Subsequently, the proposed changes can be approved directly by the Operations Director.

c. Route Viability

Another level of assessment practiced at the MBTA relates to the elimination of service which is no longer found to be ecomonically viable. Initially, revenue data, reported for each route on a quarterly basis, is used as a preliminary indicator in the ranking of routes. Routes of unsatisfactory revenue performance are subsequently ranked for the following measures:

- average operating speed
- average schedule speed
- labor productivity by route and garage
- complaints

Next, routes identified as being substandard are given a thorough review, using characteristic counts and on-board survey data. On the basis of this review, a decision is made either to initiate remedial action to improve performance, or to discontinue the service.

2. Service Policy for Surface Transportation

The MBTA was among the pioneer transit authorities in the U.S. to adopt service standards for bus service evaluation. They were endorsed by the Advisory Board in December 1975 and revised in 1977. The general statement of the purpose of the Service Standards is stated in Section 1.2 of the document:

> "Purpose
>
> General Statement
>
> Establish a system of management policy that is prudent, effective, and responsive for use in guiding the operation and improvement of surface transit services within the MBTA district.
>
> a. Provide a uniform and effective basis for evaluating the relative costs, benefits, and overall performance of individual services.
>
> b. Provide a responsive and effective methodology for establishing new services and improvements to existing services.
>
> c. Provide a consistent basis for determining the operating responsibility for individual services and supplemental financing arrangements for 'substandard' services."

In the remainder of this section, a list of the current standards and guidelines is provided. They are contained in three groups according to the function they serve:

- Service Design Guidelines
- Operating Performance Standards
- Economic/Social/Environmental Standards

a. Service Design Guidelines

- spatial guidelines
- directness of service
- route layout
- frequency of service
- temporal guidelines
- passenger stops
- passenger shelters
- market potential

b. Operating Performance Standards

- speed
- recovery time
- load factors
- labor productivity
- schedule adherence
- service dependability
- complaints

c. Economic/Social/Environmental Standards

- revenue to cost ratio
- passengers per hour
- passengers per mile
- transit dependency
- elderly and handicapped dependency

3. Data Resources

This section discusses the current bus service information collected by the MBTA. Data providing insights to the market served by the bus network is collected on an individual route basis. Data concerning bus operations, such as missed trips or disabled vehicles, are compiled by the specific garages.

a. Scheduled Trips by Route

This file includes the schedule times for each bus trip, the time it leaves the terminal, arrives at its destination, leaves its destination, and arrives back at the terminal. The information is used to develop reports on schedule operating speed and scheduled route miles. It serves as a basis for the service performance report, for allocating costs, and for town assessments.

b. Route Profiles

The route profiles contain information on route mileage and mileage by town. This data is updated whenever a route is changed in any way. The route profiles also serve as the main source for allocating mileage for town assessments.

c. Route Cost Data

Costs incurred in bus route operations are allocated to bus routes based on scheduled trips derived from the schedule trip file. Cost data is utilized to compute revenue to cost ratios and to determine the costs allocated to towns within the MBTA district.

d. Route Revenue Data

Revenue data is collected and recorded daily by the MBTA's six rating stations. Allocation of revenue to each bus route is calculated based on factors reflecting the percentage of the rating station collections from each route. The factors are computed during a oneweek revenue reading period per quarter, when operators record the farebox readings every time they change routes. Then, assuming stability of these factors over the three-month period, they are applied to all other weeks during the quarter. These quarterly summaries are used to calculate economic performance measures, such as revenue to cost ratios, revenue per mile, revenue per hour, revenue per passenger and town assessments.

e. Traffic Checker Counts

Traffic checkers perform three types of counts: peak-load point counts, characteristic counts, and specialized route segment counts. All counts provide the MBTA Plans and Schedules Department with route specific data on ridership by time of day. However, the level of detail varies between the types of counts. A description of each type of count follows:

- Peak-load point counts are performed once a rating period for each route. These are not stored on computer file. The traffic checker stands at the peak-load points and records the date, weather, location of count, the time, vehicle number, and number of passengers on board for every bus passing that point. The counts are then summarized by time period, and by intervals within the time period. Total ridership per time period is divided by number of vehicles per time period to determine average loading.

- Characteristic counts are performed on request from various departments in the Authority. As a result, current profiles are not available for most routes. These are also not stored on computer file. The traffic checker rides the bus and records date, weather, scheduled time it leaves, actual time it leaves, passenger boardings and alightings, and time it arrives. The counts are summarized manually to provide total passengers on board, time leave, time arrive, and elapsed time of trip.

- Specialized counts are designed to provide data for specific purposes and they are summarized as needed by the department requesting the information.

All summaries are used by the Schedules and Service Planning Departments. The Schedules Department uses the information to make minor changes in the schedules. Service Planning uses the information to evaluate route change proposals, service changes, and new routes. Information derived manually from traffic checker counts include passengers/mile, passengers/hour, average fare, passengers/trip, and ridership by route segment. Although it has not been done previously, the traffic counts could also be used to provide statistics on schedule adherence and the number of standees.

f. Bus Stop Location File

This is a computer file which contains the location (nearest street intersection), length, and town location of all bus stops, and distance between them. The distance information is used to calculate bus passenger miles, a requirement for Section 15 of the 1979 Surface Transportation Act.

g. Garage Operation Forms

A variety of forms are used for management control in the Transportation Division.

- The Motor Bus Operation Form or Bus Pullout Assignment Sheet is used for bus assignment. The form contains information on operator name, bus number, time pullout, route number, run number, time put up. It is also used to note when a bus is not available for a scheduled trip, or how many trips are missed if the bus is dispatched late.

- The Daily Report of Defects provides data on vehicle number, route number, operator number, time defect occurred, whether passengers were unloaded or shifted to another bus, the length of the delay, and the description of the defect. From this report, it can also be determined if any trips were missed due to a disabled bus, and which route was affected.

- The Assignment Block form is used to record daily manpower coverage of scheduled runs or any portion, as well as the assignment of additional trips.

- A Variation from Schedules form is used to record any variation due to late departures or missed or added trips. The date and the operator, route, trip time, and reason for each variation are also recorded.

- The Daily Lost Trips form summarizes lost trips by run number, trip time, route number, number of trips affected, operator number, and the reason for the loss. The garage sends the completed form daily to the Revenue Department. The Revenue Department uses the information to make corrections in revenue miles operated for town assessment purposes.

h. Daily Service Report

This report contains information compiled from the garages on the number of trips run, missed, or added the previous day. It also records the number of buses not available in each garage.

i. Consumer Commendation/Complaints File

Commendations and complaints are recorded by telephone operators on forms which include information on route, time of day, type of complaint, and date of complaint. The forms are manually summarized and used only by the Public Affairs and Information Department.

4. Critique of Bus Evaluation Process

This section of the report addresses the weaknesses of the current MBTA evaluation program. These problem areas were identified from the completion of the review of the procedures, standards, and data resources in the previous sections.

a. Service Planning and Evaluation Procedures

The review reveals that, although detailed guidelines currently exist for the analysis and assessment of existing services and new proposals, these procedures are being only partially followed. Generally, evaluation is only exercised, upon special request, on new proposals and route rankings. Systematic analysis of existing services on a route-by-route basis is nonexistent. Constraints on the time available to MBTA personnel involved in the process and lack of recent valid data appear to be the major reasons. The monitoring of passenger loads is one procedure in use on a continuous basis, but it is not rigorously documented.

b. Service Standards and Guidelines

For the most part, service standards and guidelines are judged to be sufficient, if supported by adequate data and utilized systematically, and could cover the assessment of a variety of situations. However, current utilization of standards is mainly restricted to service design and to those standards on operating performance which have a direct impact on the service as perceived by the riding passenger: headways, speed, load factors, schedule adherence, service dependability, and complaints. These standards are used quite actively, because they are comprehensive, easy to apply, and utilize readily available data.

On the other hand, efficiency standards, such as recovery time and labor productivity, which are extremely important to monitor for management cost control, have not realized wide utilization. Revenue to direct cost rating, passengers per hour, and passengers per mile are used for the assessments of economic performance of routes, but these standards have experienced associated data problems.

In summary, application of standards is biased towards effectiveness of service, while supply evaluation is neglected. Sole reliance on effectiveness measures does not lead to improvements since these measures are mostly useful in identifying the problems and not their causes.

APPENDIX A-6 -- SUMMARY OF STUDIES AND LEGISLATIVE PROPOSALS INITIATED TO IMPROVE THE MBTA

Over the past decade, several committees and task forces have been organized to investigate and make recommendations on ways to improve the MBTA. The MBTA's management structure has been reorganized through State Legislation twice during this period, first in 1973 and again in 1980. A review of the changes in the organizational structure and the outcome of these task force studies are presented in this section. Also included is a compilation of all legislation filed in the State Legislature between 1973 and 1982. Although none of the bills in the listing were enacted, this compilation serves to show the types and volume of the proposals which have been brought before the State Legislature for review.

The problems confronting the MBTA today are basically the same as those discussed ten years ago--declining ridership and service levels, less than optimal productivity and efficiency levels, increasing cost of service, and taxpayer complaints about higher taxes. A task force formed by Governor Sargent in 1970 to investigate transportation policies and programs in the state offered several reasons for the MBTA's problems. The task force pointed to a long history of a deficit operation and a preoccupation with capital expansion. They found a general neglect of preventive maintenance and modernization over the previous years. The MBTA's union work rules, politics, and lack of contract work were also noted as contributing to the problems. Recommendations of the Governor's task force included ways to improve efficiency and reduce the deficit. A proposal to set-up a state tax fund for transit was made. The task force further suggested that the unions and management work together, and proposed a stronger management structure centered at EOTC.

During this same time, a special commission was set-up initially under Chapter 126 of the Resolves of 1967 and continued through 1970 under Chapter 3 of the Resolves of 1970. The commission was formed to "make an investigation and study relative to the finances and operation of the MBTA". They made six reports to the State Legislature during this time period, addressing such issues as the MBTA's capital expansion program, its financial management and its legal structure. The commission's work proceeded under several governing principles among which were the following:

1) That an increase in the level and extent of public transportation in Boston is essential to the continued availability and growth of downtown Boston;

2) that any system be sufficiently attractive to induce auto commuters to switch to transit;

3) that major improvements be made on rail; and

4) that the cost of service be charged as fairly as possible to those receiving the benefits.

The special commission came to several conclusions and proposed recommendations on the basis of several hearings, special task force reports, and consultant reports over the four years. In addition to assigning priorities to capital improvement programs and recommending methods to improve the allocation of the net cost of local service, the commission proposed a reorganization of the management structure of the MBTA. They concluded that the law that set-up the authority allowed for inefficiencies in providing service to the communities, although they concluded the MBTA had provided a net benefit to the area. The commission suggested that the power in the authority be concentrated in one individual, a commissioner, appointed by the Governor. It also proposed abolishing the Board of Directors and the General Manager's position. Another commission was set-up by Governor Sargent in August 1972 to propose specific changes in the organization, administration, and finances of the MBTA.

In 1973, Governor Sargent filed legislation to reorganize EOTC and the MBTA. The purposes were to increase the executive authority and accountability at the MBTA; to enable the Advisory Board and General Court to control costs more effectively; and to facilitate comprehensive transportation planning. Chapter 1140 of the Acts of 1973 provided for some changes in the administration and management, which included combining the positions of Chairman and Chief Executive Officer, although the MBTA was still under the direction of a five-member Board of Directors. In 1974, the funding system was changed such that the state provided 50 percent of the MBTA's net deficit and the Federal Government provided operating assistance as authorized under the Urban Mass Transportation Act of 1974. The reorganization took effect in January 1, 1975.

By the end of 1976, the reorganization was viewed as a success and seemed to be alleviating some of the MBTA's problems. There were still some concerns expressed specifically by the Advisory Board about the distribution of the state's share of deficit to express service, about inequities in the local assessment formula, and about the dependence upon the local property tax to cover the local share of the MBTA's deficit. As a solution to the local financial burden on the property tax, the Advisory Board recommended using revenue from an increased sales tax, a broader based sales tax, a tax on gasoline, or a regional payroll tax.

The late 70's saw increasing costs and a greater burden of those costs on taxpayers, although ridership was increasing. Financial problems were evident throughout this system and once again in 1980, the Governor and the Secretary of Transportation appointed a task force to make recommendations for improving the Authority's performance. They looked at both short-term solutions to the financial problem of 1980 and long-term solutions that would develop a funding mechanism and management structure to avoid future financial crises. The task force proposed changes in the managerial structure of the MBTA, changes in their funding sources (motor fuels tax, toll tax, parking tax), assessment policies and fares (increase rapid transit by 25 cents), revisions to the financial planning and cost accounting methods, as well as changes to the labor/management relationship. They proposed that legislation be drafted that would give the "T" the authority it needs to make changes to improve service, reduce the burden on the property tax, and reverse the negative public perception of the MBTA.

Following a one-day shutdown on the MBTA in December 1980 due to depleted operating funds, the State Legislature passed an emergency bill to allocate additional revenue to operate the MBTA through the end of the year and reorganize several aspects of their operations. Major components of this legislation, Chapter 581 of the Acts of 1980, are as follows:

- Re-created a General Manager's position;
- increased the size of the Board of Directors to seven members with the Secretary of Transportation as the Chairman;
- created a position for a Governor's designee on the Advisory Board to have voting power equal to that of the largest member;
- assigned several rights to management covering employment policies, service policies, and productivity standards; and
- placed a 4 percent cap on the operating budget of the MBTA.

In 1981, the MBTA's management started to exercise some of the rights obtained from the 1980 legislation, following a court ruling in their favor over the legality of the law. The benefits of the reorganization will start to materialize in the near future. Some of the work rule changes which came out of this are included in Appendix D. With the ilntent of improving the accountability at the "T", the Massachusetts Taxpayers Foundation, Inc. proposed a reporting system that would directly relate service to cost. Detailed information would be gathered on service, both quantity--riders, hours of operation, and revenue; and quality--reliability, regularity; costs such as wages, expenses, capital; efficiency measures; effectiveness measures; and, comparability to other systems of time periods. Currently, the MBTA is making an effort to obtain better operating data through the institution of an annual ridership survey and the maintenance of base data for future comparison and analysis.

A detailed listing of studies initiated to improve the MBTA follows as a resource for those interested in further study of the issue.

APPENDIX A-6 (cont.)
LISTING OF STUDIES TO IMPROVE THE MBTA

Central Transportation Planning Staff, Technical Report No. 26, MBTA Systemwide Passenger Data Collection Program, Volume 1: Rapid Transit System, April 1981.

Central Transportation Planning Staff, Commuter Rail Improvement Program, 1978.

Commonwealth of Massachusetts, Interim Report of the Special Commission Established to Make an Investigation and Study Relative to the Finances and Operation of the Massachusetts Bay Transportation Authority, March 1970, Senator James R. McIntyre, Chairman.

Commonwealth of Massachusetts, Executive Office of Transportation and Construction, Reorganization Legislation, Phase II, March 1973.

Decision Research Corporation, Dime Time Ridership, Study No. 2, for MBTA, (Wellesley Hills, Massachusetts; Decision Research), June 1974.

Governor's Task Force on Transportation, A. Altshuler, Chairman, Report to Governor Sargent, Part II, June 1970.

Massachusetts Bay Transportation Authority, 1981 Current Expense Budget and Auxiliary Data, Boston, 1981.

Massachusetts Bay Transportation Authority, The Legal Structure and Management of the MBTA, October 1980.

Massachusetts Bay Transportation Authority, Title VI Assessment for Capital and Operating Assistance, December 1981.

Massachusetts Bay Transportation Authority, Bus Service Evaluation Procedures: A Review, 1979

Massachusetts Bay Transportation Authority, Five Year Development Program 1973-1977, 1973

Massachusetts Bay Transportation Authority, Report of the Fare Policy Committee on Fare Structure and Fare Levels, 1980.

Massachusetts Bay Transportation Authority, Service Policy for Surface Public Transportation, 1977.

Massachusetts Bay Transportation Authority, Service Policy for Surface Public Transporatation, 1975.

Massachusetts Bay Transportation Authority, "T" Preventive Maintenance Program for Buses, 1980.

Massachusetts Bay Transportation Authority, Ten Year Transit Development Program 1974-1983, 1974.

Massachusetts Bay Transportation Authority, Transit Information Study, 1971.

Massachusetts Bay Transportation Authority Advisory Board, Labor Costs at the MBTA, 1980.

Massachusetts Bay Transportation Authority Advisory Board, Public Transportation Financing - A Survey of Options for Alternatives to the Property Tax Which Has Hampered Massachusetts Economic Development, Staff Draft, October 1976.

Massachusetts Bay Transportation Authority Advisory Board, Report of the Budget Committee on MBTA Service Performance, Budget Performance, Department Performance, 1975.

Massachusetts Executive Office of Transportation and Construction, Transportation Needs - Transportation Services, Staff Report #1, 1976.

Massachusetts Executive Office of Transportation and Construction, Transportation Technologies: Applicability and Cost Effectiveness, Staff Report #2, 1976.

Massachusetts Executive Office of Transportation and Construction, Capital Needs for the Existing Plant and Vehicle Replacement, Staff Report #3, 1976.

Massachusetts Executive Office of Transportation and Construction, 4A Service Quality and Efficiency, 4B Needs for Elderly and Handicapped, Staff Report #4, 1976.

Massachusetts Executive Office of Transportation and Construction, Capital Needs at the Corridor Level, Staff Report #5, 1976.

Massachusetts Executive Office of Transportation and Construction, Priorities and Budgets, Staff Report #6, 1976.

Massachusetts Executive Office of Transportation and Construction, Management Policies Affecting the Capital Program, Staff Report #7, 1976.

Massachusetts Executive Office of Transportation and Construction, Five Year Transit Development Program, Boston Region 1975-1980, 1975.

Massachusetts Great and General Court, An Act Relative to the Structure of the MBTA (Chapter 581, Acts of 1980).

Massachusetts Great and General Court, Special Commission Relative to the Finances and Operation of the MBTA, 1971.

Massachusetts Governor's Commission to Examine the Financing and Organization of the MBTA, 1972

Massachusetts Legislation Special Commission, Relative to the Finances and Operation of the MBTA, 1969.

Massachusetts Taxpayers Foundation, Inc., What's Missing at the T, 1981.

Palmere, Anthony J., Alternatives for Financing the MBTA, (unpublished thesis), John F. Kennedy School of Government, Harvard University, April 1981.

Transportation Policy Workshop, Department of City and Regional Planning, Harvard University, Evaluation of Alternative Fare Structures for the Massachusetts Bay Transportation Authority, Cambridge, Massachusetts, May 1980.

APPENDIX A-7 : Legislation which has been filed from 1973 - 1982 relative to State Aid for the M.B.T.A.

**MASSACHUSETTS
BAY
TRANSPORTATION
AUTHORITY**

To: Donald Kidston
Development Coordinator

From: James D. Harrington
Legislative Counsel

Date: July 20, 1983

Attached hereto please find lists of legislation filed from 1973 to 1982 relative to state aid for the M.B.T.A. None of these bills was enacted as filed; they merely reflected the interest of various legislators. During this period, the Commonwealth did assume part of the M.B.T.A. net cost of service. This was done through the General Appropriations Act each year (The Budget).

James D. Harrington
Legislative Counsel

JDH:cg

Attachments (10)

1973

S. 1336 - Petition of John W. Bullock, John F. Cusack and Eleanor M. Campobasso for legislation to provide that the Commonwealth assume the entire deficit of the MBTA.

S. 1352 - Petition of Arthur Joseph Lewis, Jr. for legislation to require the Commonwealth to assume all the costs of operation of the MBTA.

S. 1359 - Petition of Denis L. McKenna for legislation to require the Commonwealth to assume all the costs of operation of the MBTA.

S. 1379 - Petition of Mario Umana and another for legislation to provide payment by the Commonwealth of certain costs of mass transportation service in the Commonwealth.

H. 776 - Petition of Richard F. Finnegan that the entire net cost of service of the MBTA be paid by the Commonwealth without assessment to cities and towns.

H. 1155 - Petition of Alan Paul Danovitch that the Commonwealth assume the cost of operation of the MBTA.

H. 1439 - Petition of Francis D. Doris that the Commonwealth pay the entire deficit of the net cost of service of the operations of the MBTA's express service.

H. 2798 - Petition of Thomas F. Brownell that the Commonwealth assume the entire cost of the deficit of the MBTA.

H. 3590 - Petition of Thomas D. Mann, William F. Hogano and others that the Commonwealth be required to assume the cost of operation of the MBTA.

H. 3774 - Petition of Raymond L. Flynn that the Commonwealth assume all the costs of the operation of the MBTA.

H. 3872 - Petition of John F. Melia and Michael J. Daley for legislation to provide that the Commonwealth assume the payment of the annual deficit of the MBTA.

H. 4054 - Petition of James J. Cronin, Jr. that the Commonwealth assume the cost of operation of the MBTA.

H. 4057 - Petition of Kevin H. White and John F. Melia for legislation to provide for payment by the Commonwealth of certain costs of mass transportation services.

H. 4249 - Petition of William J. Dignan that the Commonwealth be required to assume all costs of operation of the MBTA.

H. 4255 - Petition of James E. Smith, John F. Cusack and others that the Commonwealth assume the payment of certain costs of the MBTA.

1973, cont'd.

H. 4448 - Petition of John J. Finnegan for legislation to provide that the Commonwealth assume the payment of the annual deficit of the MBTA.

H. 4829 - Petition of William A. Carey for legislation to provide that the Commonwealth assume the payment of the annual deficit of the MBTA.

H. 4836 - Petition of Clifford H. Marshall that the Commonwealth assume the entire cost of operating the MBTA.

H. 5211 - Petition of Timothy A. Bassett that the Commonwealth assume the cost of operation of the MBTA.

1974

H. 2296 - Petition of Michael J. Daley and John F. Melia for legislation to provide that the Commonwealth assume the payment of the annual deficit of the MBTA.

H. 2301 - Petition of Board of Directors of the MBTA and W. Paul White relative to the organization and financing of said Authority.

H. 2852 - Petition of Melanie Kay and Barney Frank for the state assumption of half of the cost of services of the MBTA.

H. 3224 - Petition of Alan Paul Danovitch that the Commonwealth assume the cost of operation of the MBTA.

H. 3834 - Petition of Charles Robert Doyle that provision be made for the state assumption of the annual deficit of the MBTA.

H. 4837 - Petition of James J. Craven, Jr. for legislation to require the Commonwealth of Massachusetts to assume all the costs of the operation of the MBTA.

1975

S. 1496 - Petition of Jack H. Backman for legislation to provide payment by the Commonwealth of fifty percent of the cost of mass transportation service in the Commonwealth.

S. 1499 - Petition of Walter J. Boverini for legislation to require the Commonwealth to pick up the total cost of operating expenses of the extension of the Massachusetts Bay Transportation Authority blue line.

S. 1504 - Petition of John W. Bullock for legislation to require the Commonwealth to assume all the costs of the operation of the Massachusetts Bay Transportation Authority.

H. 718 - Petition of Raymond F. Rourke relative to improving the efficiency of the Massachusetts Bay Transportation Authority and providing for increased state aid.

H. 2212 - Petition of W. Paul White for legislation to provide additional financial assistance by the Commonwealth for the operation of the Massachusetts Bay Transportation Authority.

H. 3419 - Petition of Kevin H. White, Barney Frank, John F. Melia and another for legislation to provide for state payment of fifty percent of the net cost of operating the Massachusetts Bay Transportation Authority.

1976

H. 438 - Petition of Thomas F. Brownell relative to the assumption by the Commonwealth of the costs of the annual deficit of the Massachusetts Bay Transportation Authority.

H. 989 - Petition of the Board of Directors of the Massachusetts Bay Transportation Authority and W. Paul White relative to the financing of said Authority.

H. 1452 - Petition of Robert W. Gilette and William J. Flynn, Jr., relative to improving the efficiency of the Massachusetts Bay Transportation Authority and providing for increased state aid.

H. 2024 - Petition of John F. Melia that provision be made for the Commonwealth to assume fifty percent of the cost of the Massachusetts Bay Transportation Authority.

H. 2582 - Petition of Kevin H. White, John E. Melia and another that the Commonwealth assume fifty percent of the net costs of service of the Massachusetts Bay Transportation Authority.

H. 2765 - Petition of Theodore D. Mann, David J. Mofenson, Lois G. Pines, Jack H. Backman and Richard J. McGrath that the Commonwealth assume the full cost of mass transportation services in the Commonwealth.

H. 3133 - Petition of Brian J. Donnelly that all cities and towns of the Commonwealth be responsible for the payment of the annual deficit of the Massachusetts Bay Transportation Authority.

H. 3918 - Petition of Eleanor M. Campobasso that the Commonwealth assume the entire cost of the deficit of the Massachusetts Bay Transportation Authority.

H. 4112 - Petition of John F. Cusack that seventy-five percent of the net cost of service of the Massachusetts Bay Transportation Authority be paid by the Commonwealth and not assessed upon the cities and towns included in the districts constituting said Authority.

1977

S. 1273 - Petition of Jack H. Backman for legislation to establish the MBTA agency and state funding of the M.B.T.A.

H. 572 - Petition of William J. Flynn, Jr., relative to improving the efficiency of the MBTA and providing for increased state aid.

H. 1738 - Petition of Carla B. Johnston that provision be made for the payment by the Commonwealth of fifty percent of the net cost of service of the MBTA.

H. 2869 - Petition of Theodore D. Mann, David J. Mofenson, Jack H. Backman, A. Joseph DeNucci and Lois H. Pines for the assumption by the Commonwealth of the entire cost of transportation services.

H. 2870 - Petition of the Board of Directors of the MBTA and W. Paul White relative to the financing of said Authority.

H. 3658 - Petition of Brian J. Donnelly for legislation to require that all of the cities and towns of the Commonwealth be required to assume the payment of the annual deficit of the Massachusetts Bay Transportation Authority.

H. 3659 - Petition of the Massachusetts Mayors' Association, Paul E. Means, James E. Smith and A. Jasper DeNucci for legislation to require the payment by the Commonwealth of one hundred percent of the net cost of service of the MBTA.

H. 4203 - Petition of Brian J. Donnelly that all costs of operation of the MBTA be assumed by the Commonwealth.

H. 4564 - Petition of Richard A. Voke that the Commonwealth assume the entire deficit of the MBTA.

H. 4696 - Petition of Thomas F. Brownell and another that provision be made for payment by the Commonwealth of the net cost of service of the MBTA.

H. 4700 - Petition of Michael McGlynn for legislation to require that the Commonwealth assume the net cost of service of the MBTA.

1978

S. 1202 - Petition of Jack H. Backman for legislation to establish the Massachusetts transportation agency and state funding of the Massachusetts Bay Transportation Authority.

S. 1244 - Petition of Arthur H. Tobin and members of the House of Representatives that provision be made for an investigation and study by a special commission (including members of the General Court) relative to the operation, maintenance and finances of the Massachusetts Bay Transportation Authority.

H. 1312 - Petition of the Board of Directors of the Massachusetts Bay Transportation Authority, Lincoln P. Cole, Jr., and W. Paul White relative to the financing of said Authority.

H. 1928 - Petition of Kevin H. White and Barney Frank relative to the finances and organization of the Massachusetts Bay Transportation Authority.

H. 2501 - Petition of William J. Flynn, Jr., Anna P. Buckley, and Paul F. X. Moriarty relative to improve the efficiency of the Massachusetts Bay Transprotation Authority and providing for increased state aid.

H. 2867 - Petition of Brian J. Donnelly and Richard L. Walsh that the annual deficit of the Massachusetts Bay Transportation Authority be paid by all the cities and towns of the Commonwealth.

H. 3037 - Petition of Louis R. Nickinello and other members of the General Court relative to the finances and organization of the Massachusetts Bay Transportation Authority.

H. 3423 - Petition of John A. Businger to provide for fifty percent state assistance to the Massachusetts Bay Transportation Authority.

H. 3621 - Petition of Norman S. Weinberg relative to adjusting the formula for allocating the deficit of the Massachusetts Bay Transportation Authority.

H. 3970 - Petition of Charles Robert Doyle that the Commonwealth assume the entire deficit of the Massachusetts Bay Transportation Authority.

S. 1516 - Petition of Larry M. Means and John A. Brennan, Jr., for legislation to relieve the deficit assessment of the Massachusetts Bay Transportation Authority from the cities and towns and providing for 100 percent assumption by the Commonwealth.

H. 434 - Petition of William J. Flynn, Jr., relative to authorizing the towns of Ashland, Dover, Duxbury, hanover, Hamilton, Lynnfield, Marshfield, Medfield, Middleton, Millis, Norwell, Pembroke, Rockland, Sherborn and Topsfield to withdraw from the Massachusetts Bay Transportation Authority.

H. 1305 - Petition of Richard A. Voke that provision be made for the Commonwealth to assume the entire deficit of the Massachusetts Bay Transportation Authority.

H. 1924 - Petition of the Board of Directors of the Massachusetts Bay Transportation Authority, W. Paul White and Lincoln P. Cole, Jr., relative to the financing of said Authority.

H. 2116 - Petition of James V. Young and Daniel F. Pokaski relative to the finances and organization of the Massachusetts Bay Transportation Authority.

H. 2307 - Petition of Theodore D. Mann, Jack H. Backman, David B. Cohen, A. Joseph DeNucci and David J. Mofenson for legislation to require the Commonwealth to assume one hundred percent of the cost of mass transportation.

H. 2487 - Petition of John F. Cusack and Andrew J. Rogers, Jr., that the Commonwealth be required to assume full cost of the annual deficit of the Massachusetts Bay Transportation Authority.

H. 2853 - Petition of Charles F. Flaherty, Jr., and Barney Frank relative to the finances and organization of the Massachusetts Bay Transportation Authority.

H. 3063 - Petition of Richard L. Walsh relative to requiring the Commonwealth to assume all the costs of operation of the Massachusetts Bay Transportation Authority.

H. 3064 - Petition of Richard L. Walsh that provision be made for all of the cities and towns of the Commonwealth to assume the payment of the annual deficit of the Massachusetts Bay Transportation Authority.

H. 4094 - Petition of John A. Businger for legislation to provide for fifty percent state assistance to the Massachusetts Bay Transportation Authority.

H. 4099 - Petition of Louis R. Nickinello, Sherman W. Saltmarsh, Jr., John E. Murphy, Jr., Samuel Rotondi, Alfred A. Minahan, Jr., Andrew J. Rogers, Jr., Michael J. McGlynn, Elizabeth N. Metayer and another relative to the finances and organization of the Massachusetts Bay Transportation Authority.

H. 5046 - Petition of Charles Robert Doyle that the Commonwealth assume the entire deficit of the Massachusetts Bay Transportation Authority.

1980

H. 435 - Petition of Charles Robert Doyle that the Commonwealth assume the entire deficit of the Massachusetts Bay Transportation Authority.

H. 1190 - Petition of John F. Melia and another for legislation to decrease the cost of the Massachusetts Bay Transportation Authority to the property taxpayers of the Commonwealth.

H. 1393 - Petition of Richard A. Voke, Richard L. Walsh, John A. Businger, Philip W. Johnston and Gregory Williams Sullivan relative to requiring the Commonwealth to assume the entire cost of operation of the Massachusetts Bay Transportation Authority.

H. 1965 - Petition of the Board of Directors of the Massachusetts Bay Transportation Authority and W. Paul White relative to the financing of said Authority.

H. 2929 - Petition of John F. Cusack and Andrew J. Rogers, Jr., that provision be made for state assumption of the entire annual deficit of the Massachusetts Bay Transportation Authority.

H. 4641 - Petition of Richard L. Walsh that provision be made for all of the cities and towns of the Commonwealth to assume the payment of the annual deficit of the Massachusetts Bay Transportation Authority.

H. 4642 - Petition of Richard L. Walsh relative to requiring the Commonwealth to assume all the costs of operation of the Massachusetts Bay Transportation Authority.

H. 5031 - Petition of William J. Flynn, Jr., for legislation to require the Commonwealth to assume seventy percent of the assessments payable by cities and towns comprising the territory of the Massachusetts Bay Transportation Authority.

H. 5032 - Petition of William J. Flynn, Jr., relative to improving the efficiency of the Massachusetts Bay Transportation Authority and providing for increased state aid.

H. 5283 - Petition of William J. Flynn, Jr., that provision be made for the Commonwealth to pay one hundred percent of the cost of mass transportation services.

1981

H. 895 - Petition of William J. Flynn, Jr. for legislation to require the Commonwealth to assume seventy percent of the assessments payable by cities and towns comprising the territory of the Massachusetts Bay Transportation Authority.

H. 896 - Petition of William J. Flynn, Jr. relative to improving the efficiency of the Massachusetts Bay Transportation Authority.

H. 897 - Petition of William J. Flynn, Jr. that provision be made for the Commonwealth to pay one hundred percent of the cost of mass transportation service.

H. 1633 - Petition of Charles Robert Doyle that the Commonwealth assume the entire deficit of the Massachusetts Bay Transportation Authority.

H. 2396 - Petition of Charles F. Flaherty, Jr. relative to the finances and organization of the Massachusetts Bay Transportation Authority.

H. 3844 - Petition of Theodore D. Mann, Jack H. Backman and A. Joseph DeNucci for legislation to require the Commonwealth to assume the full liability for all costs, debts and expenses related to the operation of the Massachusetts Bay Transportation Authortiy.

1982

H. 437 - Petition of William J. Flynn, Jr., for legislation to require the Commonwealth to assume seventy percent of the assessments payable by the cities and towns comprising the territory of the Massachusetts Bay Transportation Authority.

H. 438 - Petition of William J. Flynn, Jr., relative to improving the efficiency of the Massachusetts Bay Transportation Authority and providing for increased state aid.

H. 439 - Petition of William J. Flynn, Jr., that provision be made for the Commonwealth to pay one hundred percent of the costs of mass transportation services.

H. 440 - Petition of William J. Flynn, Jr., relative to the continued operation and financing of the Massachusetts Bay Transportation Authority.

H. 2376 - Petition of Nicholas A. Paleologos relative to the continued operation and financing of the Massachusetts Bay Transportation Authority.

H. 3094 - Petition of Louis R. Nickinello relative to the continued operation and financing of the Massachusetts Bay Transportation Authority.

H. 3700 - Petition of Thomas F. Brownell for legislation to require that all deficit expenditures of the Massachusetts Bay Transportation Authority be funded by the Commonwealth and prohibiting such costs from being assessed upon any cities or towns.

APPENDIX A - 8 : Letters on Mitigating Measures from the M.B.T.A.

MASSACHUSETTS
BAY
TRANSPORTATION
AUTHORITY

James F. O'Leary
General Manager
50 High Street
Boston, Massachusetts 02110

July 18, 1983

The Honorable Kevin H. White, Mayor
City of Boston
City Hall Square
Boston, Massachusetts 02202

Dear Mayor White:

In 1982, the Central Transportation Planning Staff (CTPS) prepared an Environmental and Socioeconomic Impact Report of the MBTA's 1981 fare increase. As part of that analysis, CTPS estimated carbon monoxide (CO) concentrations at five street intersections in the City of Boston. These intersections had been designated by the Massachusetts Department of Environmental Quality Engineering as locations with potential for exceeding air quality standards for CO.

Of these five intersections, the analysis identified three with concentrations of CO which are estimated to exceed the standard of nine parts per million (ppm) for an eight-hour period.

Leverett Circle has an estimated increase in eight-hour concentrations of CO from 10.85 ppm to 11.43 ppm. As a result of the fare adjustments, the amount of CO in excess of the standard is estimated to increase.

At the interesection of Blue Hill Avenue and American Legion Highway, CO is estimated to increase from 8.87 ppm to 9.17 ppm, thereby exceeding the standard.

At the Boston University Bridge and Commonwealth Avenue, the CO concentration was estimated to remain at the above standard level of 9.79 ppm.

In accordance with the Massachusetts Department of Environmental Quality Engineering (see attached April 21, 1982 letter), the MBTA must address mitigating measures for CO to remain consistent with the State Implementation Plan for Air Quality.

The environmental impact on CO "hot spots" can be mitigated most cost-effectively through intersection redesign and other traffic engineering measures. Whereas such improvements are beyond the MBTA's jurisdiction, and two of the three intersections in question are the responsibility of the City, I am bringing these concerns to your attention.

In order to improve air quality and mitigate the adverse effects of the 1981 MBTA fare increase, as required to maintain consistency with the State Implementation Plan, I respectfully request that the City of Boston give priority to improvements at the intersection of Blue Hill Avenue and American Legion Highway and the intersection of Boston University Bridge and Commonwealth Avenue.

Thank you for your consideration.

Sincerely,

James F. O'Leary
General Manager

cc: R. Tierney

BAY
TRANSPORTATION
AUTHORITY

James F. O'Leary
General Manager
50 High Street
Boston, Massachusetts 02110

July 18, 1983

William J. Geary, Commissioner
Metropolitan District Commission
20 Somerset Street
Boston, Massachusetts 02108

Dear Commissioner Geary:

In 1982, the Central Transportation Planning Staff (CTPS) prepared an Environmental and Socioeconomic Impact Report of the MBTA's 1981 fare increase. As part of that analysis, CTPS estimated carbon monoxide (CO) concentrations at five street intersections in the City of Boston. These intersections had been designated by the Massachusetts Department of Environmental Quality Engineering as locations with potential for exceeding air quality standards for CO.

Of these five intersections, the analysis identified three with concentrations of CO which are estimated to exceed the standard of nine parts per million (ppm) for an eight-hour period. One of these intersections is under the jurisdiction of the MDC.

Leverett Circle has an estimated increase in eight-hour concentrations of CO from 10.85 ppm to 11.43 ppm. As a result of the fare adjustments, the amount of CO in excess of the standard is estimated to increase.

The remaining two intersections of concern are under the jurisdiction of the City of Boston.

The environmental impact on CO "hot spots" can be mitigated most cost-effectively through intersection redesign and other traffic engineering measures. Whereas such improvements for Leverett Circle are within MDC's area of control, I am bringing this matter to your attention.

In accordance with the Massachusetts Department of Environmental Quality Engineering (see attached April 21, 1982 letter), the MBTA must address mitigating measures for CO to remain consistent with the State Implementation Plan for Air Quality.

In order to improve air quality, mitigate the adverse effects of the 1981 MBTA fare increase and in response to DEQE's letter of April 21, 1983, I respectfully request that the MDC give priority to improvements at Leverett Circle.

Thank you for your consideration.

Sincerely,

James F. O'Leary
General Manager

cc: R. Tierney

APPENDIX B

Ridership Estimation Technique

APPENDIX B

RIDERSHIP ESTIMATION TECHNIQUE

The MBTA does not regularly count the number of riders it is carrying systemwide. It does, however, take periodic counts on buses and at selected rapid transit stations. Total system ridership can be derived from base information collected during these counts and from regularly collected revenue data adjusted by estimates of average fare levels. The methods currently used to estimate ridership are described below.

Three types of bus counts are made: (1) peak load point counts, (2) characteristic counts, and (3) specialized route segment counts. Peak load counts are made by the MBTA checkers once each quarter for each bus route. The number of passengers on each bus on a given route are recorded at the point of peak load. The data is collected by a checker who is outside the vehicle and must estimate the total number of riders. The data is then summarized to determine riders per bus over various time periods. Characteristic counts are performed by the MBTA upon special request from an MBTA department. The data collected provides total passenger boardings and elapsed time of a trip for the bus route under study. Specialized counts are also taken as needed and counts that provide information on fare type, pass usage, or ridership profile.

Turnstile readings and token counts are made on a daily basis and give some indication of the number of riders on the rapid transit lines. Passmeter readings are also reported daily; however, the reliability of these counts is questionable due to frequent equipment failures, which cause an understatement of ridership levels. The third component of rapid transit ridersip counts involves estimating the number of individuals who use the collector's turnstile or cash gates and whose presence is only recorded as revenue collected in the cash box. An average fare of these riders is necessary to estimate ridership levels.

To determine system ridership levels, revenue collected during a given time period is divided by the average fare paid on the system. This method can be applied separately to surface revenue and to rapid transit revenue, using the appropriate average fares. There is uncertainty surrounding the use of these estimates of ridership since it is directly related to the average fare value. It is, therefore, essential that a reliable estimate of average fare be available.

The MBTA conducted a sampling program during November 1981 to determine the average fare on buses and rapid transit. The number of persons boarding and the type of fare payment, whether adult full fare, prepaid pass, elderly free, elderly half fare, student half fare or other free, was recorded for a sample of buses and surface streetcars. In addition, revenue collected for

APPENDIX B

DERIVATION OF 1981 RIDERSHIP LEVELS

RAPID TRANSIT UNLINKED TRIPS

Tokens used in Period 11 - 3,118,706 (141,759/*average weekday*)

Pass uses -- *passmeter readings from RTL 210 turnstyle data* - 77,044

-- *passholders using gates or collectors turnstyles* - 13,301

Cash gate users

Collectors turnstyle users

> 73,595

Pass sales - 49,432

November RTL revenue - $3,932,827

↓

# of unlinked trips/average weekday - 305,699

Fare mix

Uses/pass - 44 *uses/month*

Average fare - 60.0 *cents*

SURFACE UNLINKED TRIPS

Green Line Sample -- *Average fare and fare mix*

Bus Sample -- *Average fare and fare mix*

Period 11 Surface Revenue - $3,656,678

Pass Sales - 58,184

Surface Fare Mix and Average Fare

↓

# of unlinked trips/average weekday - 422,125

Uses/pass - 57 *uses/pass/month*

Average fare - 39.6 *cents*

Total Unlinked Trips/Day = 727,824

NOTE: The survey did not include the Dorchester Branch and the Mattapan High Speed Line of the Red Line and the surface portion of theArborway Branch of the Green Line because they were closed for track reconstruction.

For additional information, see the source of this table; C.T.P.S. Tech. Report #39 1981 MBTA Fare-Mix Sampling Program: Analysis and Documentation, Feb. 1983.

DERIVATION OF 1982 RIDERSHIP LEVELS

Rapid Transit
Unlinked Trips

Tokens used in Period 11 - 3,376,144 (155,255/avg. weekday)

Pass uses -- passmeter readings from RTL210 turnstile data - 87647

-- passholders using gates or collector's turnstiles -22,581

Cash gate users
Collector's turnstile users 70,128

Pass sales - 56,715

Period II RTL revenue - $3,653,450

# of unlinked trips/average weekday - 335,581

Fare mix

Uses/pass - 39.2 uses/month

Average fare - 51.1 cents

Surface
Unlinked Trips

Green Line sample - average fare and fare mix

Bus Sample - average fare and fare mix

Period II surface revenue - $3,434,416

Pass sales - 52,359

Surface fare mix and average fare

# of unlinked trips/average weekday - 456,261

Uses/pass - 52.7 uses/pass/month

Average fare - 34.6 cents

Total Unlinked Trips/Day = 791,842

For additional information, see C.T.P.S. Tech. Report # 39 - 1981 Fare - Mix Sampling Program : Analysis and Documentation, Feb. 1983.

each surface trip was recorded. This has enabled CTPS to estimate an average surface fare in a much more accurate way than that with previously obtained data. Similar information was recorded for cash gate users at selected rapid transit stations. This data, supplemented by the turnstile token and passmeter readings permitted an estimate of average rapid transit fares.

The MBTA has proposed to undertake this type of sampling program on an annual basis. In November 1982, a second sampling was conducted and from it a ridership estimation and a calculation of average fare values for 1982 were produced. In an effort to obtain more reliable estimates of ridership, the MBTA is also investigating expanding the use of electronic pass readers to surface vehicles. This was described in Section 7.1.2 of this report. Furthermore, the MBTA will continue to examine the opportunity to build ridership counting features into other operating projects such as new types of on-board passenger counting and automatic vehicle monitoring systems.

APPENDIX C

Appendix C-1 Load Factors; Peak Hour and Direction p.321
Appendix C-2 Line Statistics for Bus Routes(by garage) Light Rail, and Rapid Transit Lines. p.335
Appendix C-3 Operating Capacities p.361

APPENDIX C - 1 : Peak Hour/Direction Load Factors for Bus Routes, Light Rail, and Rapid Transit

Appendix C

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

Load Factors - Peak Hour Peak Direction

Route Number	Route	Number of Trips	Number of Seats	Number of Passengers	Load * Factor	Date of Count
1	Harvard-Dudley/CA	5	225	385	1.71*	01/21/81
6	Army Base-South Station/CA	5	225	316	1.40*	02/25/81
7	City Point-South Station/CA	4	180	240	1.33*	02/25/81
8	Columbia Point-Dudley/CA	5	225	115	0.51	02/24/81
9	City Point-Cooley Square/CA	8	360	418	1.16*	03/10/81
10	City Point-Dudley/CA	4	180	98	0.54	02/24/81
11	City Point-Essex & Wash. via Bay View/CA	8	360	421	1.17*	03/10/81
15	Kane Square-Dudley/CA	6	270	376	1.39*	03/25/81
16	Franklin Park-Andrew	5	225	136	0.60	02/24/81
17	Fields Corner-Andrew/CA	5	225	161	0.76	02/24/81
19	Fields Corner-Dudley Sta/CA	3	135	133	0.98	03/25/81
20	Fields Corner-Neponset & Adams/Q	12	552	244	0.44	01/16/81
21	Ashmont-Forest Hills/AR	4	184	181	0.98	02/05/81
22	Ashmont-Dudley via Talbot/CA	5	225	249	1.11*	03/25/8
23	Ashmont-Dudley via Washington/CA	9	405	571	1.41*	03/25/8
24	Wakefield Avenue-Mattapan/AR	6	276	134	0.49	02/05/8
26	Ashmont-Ashmont-Norfolk-Wash	9	414	209	0.50	02/04/8
27	Mattapan-Ashmont/AR	2	92	129	1.40*	02/04/8
29	Mattapan-Egleston/AR	13	598	718	1.21*	03/26/8
30	Mattapan-Roslindale/AR	6	276	94	0.34	02/05/8
32	Cleary Square-Arborway/AR	11	506	559	1.10*	03/09/8
33	River & Milton St.-Mattapan/AR	4	184	210	1.14*	02/05/8
34	Dedham Line-Arborway/AR	10	460	460	1.00	03/03/8
34E	East Walpole-Arborway Station/AR	3	138	98	0.71	03/03/
35	Stimson & Wash-Arborway/AR	5	230	192	0.83	03/03/
36	Charles River Loop-Arborway/AR	8	368	368	1.00	03/03/

*Route with load factor which is 10% greater than the system average.

Appendix C

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

Load Factors - Peak Hour: Peak Direction

Route Number	Route	Number of Trips	Number of Seats	Number of Pas-sengers	Load * Factor	Date of Count
37	Baker & Vermont-ARborway/AR	6	276	257	0.93	03/03/81
38	Wren Street-Forest Hills Station/AR	5	230	178	0.77	09/15/80
39	Copley Square-Arborway Station/AR	24	1,104	1,421	1.29*	03/04/81
40	Georgetown-Arborway/AR	2	92	131	1.42*	03/03/81
41	Center & Eliot-Dudley/AR	5	230	233	1.00	03/26/81
42	Arborway-Dudley via Wash. St./AR	5	230	164	0.71	03/20/81
43	Egleston-Stuart & Tremont/CA	5	225	304	1.04	03/09/81
44	Seaver Street-Dudley/CA	8	360	374	1.04	03/25/81
45	Franklin Park-Dudley/CA	4	180	283	1.57*	03/25/81
46	Heath Street & So. Huntington Dudley/AR	2	92	49	0.50	03/26/81
47	Central Square-Camb.-City Hosp./CA	6	270	225	0.83	03/24/81
50	Cleary Square-Arborway/AR	4	184	170	0.92	03/03/81
51	Cleveland Circle-Arborway/AR	4	184	204	1.11*	02/04/81
55	Queensbury-Copley/CA	3	135	118	0.87	04/01/81
57	Watertown-Kenmore/AL	11	550	586	1.07	04/01/81
60	Chestnut Hill-Kenmore/AL	6	300	138	0.46	04/04/81
63	Cleveland Circle-Central Sq/B	3	135	122	0.90	02/02/81
64	Oak Square-Central Square/B	3	135	165	1.22*	02/24/81
65	Brighton Center-Kenmore/AL	4	180	193	1.07	03/04/81
66	Allston-Dudley/CA	9	405	499	1.23*	03/26/81
68	Boston City Hospital-Copley/CA	5	225	89	0.40	05/15/80 05/28/80
69	Harvard-Lechmere	5	225	98	0.43	01/28/81
71	Watertown-Harvard/Brattle/B	10	450	740	1.64*	03/20/8
72.3	Huron Avenue-Harvard	6	270	197	0.73	02/03/8
73.2	Waverly-Harvard/Brattle/B	17	765	1,198	1.57*	03/20/8
73.9	No.Camb.-Camb. Common/B	19	836	748	0.89	03/24/8

*Route with load factor which is 10% greater than the system average.

Appendix C

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

Load Factors - Peak Hour Peak Direction

ute mber	Route	Number of Trips	Number of Seats	Number of Pas-sengers	Load Factor	Date of Count
74	Belmont Center-Harvard/Brattle/B	6	270	233	1.05	02/03/81
77	Arlington Heights-Harvard/B	24	1,080	1,282	1.19*	03/24/81
78	Pleasant & Lake/B	4	180	252	1.40*	02/03/81
80	Arlington Center-Lechmere/CH	5	225	218	0.97	01/28/81
83	Rindge Avenue-Central Square/B	5	225	214	0.95	01/21/81
84	Arlmont-Harvard/B	5	225	214	0.95	03/24/81
85	Spring Hill-Kendall/B	2	90	82	0.91	01/28/81
86	Sullivan-Union Square-Allston/B	4	180	150	0.83	02/02/81
87	Clarendon Hill-Lechmere via Som/B	10	450	363	0.81	01/28/81
88	Clarendon Hill-Lechmere via Highland/B	8	360	270	0.75	01/28/81
89	Clarendon Hill-Sullivan via Broadway/CH	8	360	418	1.16*	02/03/81
91	Sullivan-Central Square/CH	6	270	106	0.39	02/02/81
92	Sullivan-Haymarket via Main St.	6	270	317	1.17*	03/02/81
93	Sullivan-Haymarket via Bunker Hill/CH	10	450	419	0.93	03/02/81
95	West Medford-Sullivan/F	5	225	159	0.71	01/27/81
96	Medford Sq-Harvard/Bra./F	7	315	387	1.24*	03/24/81
97	Malden-Wellington via Comm./F	3	135	71	0.53	12/23/80
99	Upper Highland Avenue-Well/F	4	180	144	0.80	05/07/81
00	Elm Street-Wellington/F	5	225	169	0.75	01/27/81
01	Salem Street, Sullivan/F	10	450	520	1.16*	02/03/81
04	Malden Sq-Sullivan via Ferry/CH	8	360	250	0.69	02/23/81
05	Malden-Sullivan via Faulkner/CH	2	90	89	0.99	02/23/81
06	Lebanon-Wellington/F	8	360	169	0.47	02/23/81
08	Linden Square-Wellington/F	5	225	312	1.34*	03/31/81
09	Linden Square-Sullivan via Everett/CH	5	225	188	0.84	02/23/81
10	Wonderland-Well.via/Wdlwn/CH	6	270	261	0.97	02/23/81

*Route with load factor which is 10% greater than the system average.

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

Load Factors - Peak Hour Peak Direction

oute umber	Route	Number of Trips	Number of Seats	Number of Pas-sengers	Load * Factor	Date of Count
111	Woodlawn-Haymarket/CH	9	405	496	1.02	01/26/81
112	Everett Sq-Wood Isl. via Mystic Mall/CH	3	90	75	0.83	03/05/81
116	Wonderland-Maverick via Revere St/L	4	192	200	1.04	03/19/81
117	Wonderland-Maverick via Beach/L	4	192	254	1.32*	03/19/81
119	Beachmont-City Hall/L	4	192	112	0.58	03/05/81
120	Orient Heights-Maverick/L	4	192	208	1.08	03/19/81
121	Wood Island Pk-Maverick/L	4	192	199	1.04	03/19/81
130	Melrose-Wyoming Square/L	2	96	61	0.64	12/04/80
131	Melrose-Highland-Malden/CH	3	135	168	1.24*	01/29/81
134	No. Woburn-Wellington/F	4	180	124	0.69	01/27/81
135	Wakefield Square-Malden/CH	2	90	92	1.02	01/29/81
136/137	Reading Square/Malden/CH	5	225	251	1.12*	01/29/81
170	Northwest Ind-Dudley/AL	2	90	86	0.96	3,4,5/81
210	Quincy-Fields Corner/Q	3	138	80	0.58	01/16/81
211	Quincy-Squantim/Q	2	94	93	.99	
214	Quincy-Germantown/Q	10	460	385	0.84	02/12/81
215	Quincy Center-Ashmont via Quincy/Q	5	230	243	1.06	02/11/81
216	Quincy-Hough's Neck/Q	8	368	369	1.03	02/12/81
217	Ashmont-Wollaston Beach/Q	3	138	71	0.51	02/11/81
220	Quincy-Hingham/Q	6	276	297	1.08	02/12/81
221	Quincy-Fort Point/Q	1	46	28	0.61	02/02/81
222	Quincy-E. Weymouth/Q	7	322	307	0.95	02/12/81
225	Quincy Center/Weymouth Landing/Q	8	368	282	0.77	02/11/81
230	Quincy Center-Brockton Line via Braintree Station/Q	5	230	195	0.85	02/11/81
236	Quincy Center-So. Shore Plaza/Q	2	92	61	0.66	02/11/81
238	Quincy Center-Crawford Square	3	138	100	0.72	02/11/81

*Route with load factor which is 10% greater than the system average.

Appendix C

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

Load Factors - Peak Hour Peak Direction

oute umber	Route	Number of Trips	Number of Seats	Number of Pas-sengers	Load * Factor	Date of Count
240	Crawford Square/Q	5	230	270	1.17*	02/11/81
245	Mattapan-Quincy via E. Milton/Q	3	138	140	1.01	10/22/80 10/24/80
300	Riverside-So. Station/AL	11	550	602	1.09	02/26/81
301	Brighton Center-So. Station/AL	10	500	517	1.03	02/26/81
302	Watertown-Copley Sq./AL	6	300	284	0.95	02/26/81
304	Watertown-So. Station/AL	15	750	811	1.08	02/26/81
305	Waltham-So. Station/AL	5	250	256	1.02	02/26/81
310	Needham-So. Station/AL	10	500	457	0.91	12/02/80
315	Roslindale Square-Copley/AL	2	100	90	0.90	12/02/80
325	Elm Street-Haymarket/F	5	225	251	.92	04/24/81
326	West Medford-Haymarket/F	5	225	269	.76	03/05/81
400	Central Square-Boston via Western Ave/L	4	192	226	1.18*	07/17/81
426	Central Square-Boston via Cliftondale/L	10	480	463	0.96	07/17/81
429	Cent.Sq-No.Saugus via Myrtle/L	2	96	42	0.44	04/02/81
430	Saugus-Malden/L	3	144	121	0.84	03/31/81
433	Central Square-Pine Hill/L	2	96	46	0.48	04/07/80 04/08/80
436	Central Square-Happy Valley/L	2	96	38	0.40	11/07/80
437	Central Square-Lakeside via Eastern/L	2	96	27	0.28	04/02/81
439	Central Square-Nahant/L	2	96	52	0.54	03/09/81
440	Central Square-Boston via Lynnway/L	7	336	402	1.20*	
441	Central Square-Marblehead via Paradise/L	2	96	111	1.16*	03/02/81
442	Central Square-Marblehead via Humphrey/L	2	96	114	1.18*	03/02/81
450	Salem-Boston via Western Avenue/L	7	336	382	1.14*	03/02/81
451	Salem-North Beverly/L	2	100	38	0.38	12/12/80 12/15/80
455	Salem-Lynn via Loring/L	3	144	117	0.55	02/10/81
520	Roberts-Newton Corner/AL	1	50	39	0.78	02/26/81

*Route with load factor which is 10% greater than the system average.

Appendix C

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

Load Factors - Peak Hour Peak Direction

Route Number	Route	Number of Trips	Number of Seats	Number of Passengers	Load Factor *	Date of Count
521	Waverly-Newton Corner/AL	3	100	92	0.92	02/26/81
522	Waltham Highlands-Newton Corner/AL	1	50	30	0.60	02/26/81
523	Cedarwood-Central Square/B	3	135	145	1.07	07/14/81
525	Lexington-Waltham/B	1	45	24	0.53	04/22/80 04/23/80
527	Auburndale-Newton Corner/AL	2	100	43	0.43	02/26/81
528	Hanscom-Harvard/Brattle/B	2	92	101	1.10*	03/24/81
529	Bedford VA Hospital-Arl. Heights/B	2	90	70	0.78	11/29/79
530	Five Forks-Arlington Center/B	1	45	10	0.22	07/25/80
532	Needham Jct-Watertown/AL	2	100	59	0.59	07/14/80 07/17/80
533A	Dedham Mall-Watertown/AR	3	138	74	0.48	04/23/80
700	Burlington-Boston/CH	4	180	214	1.13*	03/24/81
701	Burlington-Boston via I-93/CH	6	270	309	1.14*	09/30/8

142 Routes Recorded.

100 Routes-70% Serve Minority Areas.

41 Routes-29% have a load factor 10% greater than the system average.

29 Routes-20% have a load factor 10% greater than the system average and serve minority areas.

12 Routes-8% have a load factor 10% greater than the system average and serve non-minority areas.

Overall Load Factors - All MBTA Buses

$$\frac{\text{Total Passengers}}{\text{Total Seats}} = \frac{35,720}{36,031} = 0.994$$

10% Greater than Average Load = 1.09

AL - Albany
AR - Arborway
B - Bennett
CA - Cabot
CH - Charlestown
F - Fellsway
L - Lynn
Q - Quincy
S - Somerville

*Route with load factor which is 10% greater than the system average.

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

Rail Load Factors - AM Peak Hour/Peak Direction

Route No.	Route	Number of Trips	Number of Seats	Number of Passengers	Load Factor*	Date of Count
811	Boston College-North Station	26	1,300	2,587	1.99	03/11/81
833	Cleveland Circle-Park Street at Arlington	26	1,196	2,559	2.14	03/12/81
850	Riverside-Lechmere at Arlington	24	1,320	2,550	1.93	02/12/81
	Mattapan-Ashmont at Cedar Grove	20	920	1,202	1.31	
	Braintree-Harvard at Andrew	36	2,124	7,340	3.46	02/18/81
	Ashmont-Harvard at Andrew	36	2,124	6,119	2.88	02/18/81
	Oak Grove-Forest Hills at North Station	52	2,704	8,551	3.16	02/17/81
	Wonderland-Bowdoin at Aquarium	60	2,520	5,800	2.30	02/18/81
	TOTAL	280	14,208	36,708	2.59	

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*Designates routes which have a load factor 10 percent greater than the system load factor.

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

Light Rail Load Factors - AM Peak Hour/Peak Direction

Route No.	Route	Number of Trips	Number of Seats	Number of Passengers	Load Factor*	Date of Count
811	Green Line: Boston College-North Station	26	1,300	2,587	1.99	03/11/81
830	Green Line: Cleveland Circle-Park Street	26	1,196	2,559	2.14	03/12/81
850	Green Line: Riverside-Lechmere	24	1,320	2,550	1.93	03/12/81
	Green Line TOTAL	81	3,816	7,696	2.02	
899	Red Line: Mattapan-Ashmont	16		1,370		

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*Designates routes which have a load factor 10 percent greater than the system load factor.

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

Rapid Rail Load Factors - AM Peak Hour/Peak Direction

Route	Number of Trips	Number of Seats	Number of Passengers	Load Factor*	Date of Count
Blue Line	60	2,520	5,800	2.30	02/18/81
Orange Line	52	2,704	8,551	3.16	02/17/81
Red Line: Ashmont-Harvard	36	2,124	6,119	2.88	02/18/81
Red Line: Braintree-Harvard	36	2,124	7,340	3.46	02/18/81
Red Line TOTAL	72	4,248	13,459	3.17	

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*Designates routes which have a load factor 10 percent greater than the system load factor.

APPENDIX C - 2 : Line Statistics for Bus Routes (by garage), light rail, and rapid transit lines for Winter 1980 and Spring of 1982.

LINE STATISTICS

GARAGE: CABOT GARAGE

DATE: WINTER 1980

		WEEKDAY						WEEKEND	
ROUTE NO.	TERMINII	A.M. V.H.	BASE V.H.	2-4 V.H.	P.M. V.H.	8-10 V.H.	LATE V.H.	SAT. PEAK V.H.	SUN. PEAK V.H.
01.2	Harvard - Dudley	11-6	7-9	11-7	12-6/7	4-15	4-15	7-11	6-1
0.1	So. Station - North Sta.	4-7/8	-	2-15	3-15	-	-	-	-
0	Army Base - South Sta.	-22	-	1-34	-22	-	-	-	-
0.1	Army Base - Haymarket	4-22	-	2-22	3-22	-	-	-	-
0.8	City Point-Franklin&Arch	4-12	A	1-15	4-15	1-40	1-40	2-30	1-3
03.7	Columbus Point - Dudley	3-15	2-30	2-30	2-30	1-40	1-40	2-30	1-4
0.4	City Point - Copley +09	7-8	4-15	7-10	8-8	1-40	1-40	3-15	2-2
10	City Point - Dudley	5-10	3-20	4-20	4-16	2-40	1-40	3-20	2-3
11	City Pt.-Summer&Chauncy	10-6	4-15	9-8	9-8	1-40	1-40	5-12	2-2
13	Savin Hill-Northamp&Wash.	1-40	-	1-40	1-40	-	-	-	-
15	Kane Sq. - Dudley	5-8/7	2-15	4-9	4-9	1-30	1-30	3-10	2-1
15	Franklin Park - Andrew	*3-24	2-20	-	*3-25	1-30	1-30	2-20	2-2
6.1	Egleston - Andrew	2-24	-	4-15	2-25	-	-	-	-
7	Fields Corner - Andrew	4-11	3-15	4-15	4-12	1-40	1-40	3-15	2-2
8	Ashmont - Andrew	2-30	1-60	2-30	2-30	-	-	1-60	1-6
9	Fields Corner - Dudley	3-15	-	-	2-20	-	-	-	-
2	Ashmont-Dudley via Talbot	6-9	4-13	5-11	5-11	2-30	2-30	5-10	2-2
3	Ashmont - Dudley via Wash	9-6	4-13	5-10	6-9.	2-45	1-30	5-10	2-2
2	Egleston - Dudley	2-12	1-22	2-12	2-12	1-20	1-20	2-13	1-2
3.1	Egleston - Park & Tremont	7-9	5-12	7-9	7-9	2-30	2-30	5-11	3-2
4	Seaver - Dudley	3-9	2-12	3-12	3-9	1-30	1-30	2-12	2-1
5.1	Franklin Park - Dudley	4-8	3-12	4-10	4-10	1-32	1-32	4-9	2-1
7.2	Cent.Sq.-Camb.-Bost.C.Hsp	9-10	4-20	7-12	7-12	2-30	2-39	4-20	2-
48.1	State Hosp. - Dudley	-60	-	-	-	-	-	-	-
49.7	Northampton - Downtown	1-40	1-50	1-50	1-50	-	-	1-50	-
55	Queenberry - Copley	1-25	1-30	1-30	1-30	1-30	1-30	1-30	1-
57	Watertown - Kenmore	A	A	A	A	5-12	5-12	9-7/8	4-
60	Chestnut Hill - Kenmore	A	A	A	A	1-60	1-45	2-30	2-
65	Brighton Center - Kenmore	A	A	A	A	-	-	2-30	-
66	Allston - Dudley	9-6/7	5-12	9-8	9-8	2-30	2-30	5-12	3-
68.1	City Hospital - Copley	2-15	1-30	1-30	1-35	-	-	-	-
04.3	Watertown-Fed.&Franklin	A	A	A	A	-	-	4-15	-
20.1	Roberts - Newton Corner	A	A	A	A	-	-	2-60	1-
21.2	Waverly - Newton Corner	A	A	A	A	-	-	1-60	-
22.2	Waltham Hld. - Newton Cor.	A	A	A	A	-	-	1-60	-
27.1	Auburndale - Newton Crnr.	A	A	A	A	-	-	1-60	-
31	Framingham - Newton Crnr.	A	A	A	A	-	-	2-60	-
32	Needham - Watertown	A	A	A	A	-	-	2-45	-
	Schools	6	1	11					
	Run as directed								
4	Knndy Lbry-Columbia Shttl	-	-	-	-	-	-	1-20	1-
10	Needham-Dwntn. Shuttle	-	-	-	-	-	-	2-60	
	TOTAL	127	60	110	109	33	31	94	4

NOTES: H. Headway

V. Vehicles

.FOREST HILLS-U MASS.

A.OPERATED FROM ALBANY

LINE STATISTICS

GARAGE: ALBANY

DATE: WINTER 1980

		WEEKDAY						WEEKEND	
UTE O.	TERMINII	A.M. V.H.	BASE V.H.	2-4 V.H.	P.M. V.H.	8-10 V.H.	LATE V.H.	SAT.PEAK V.H.	SUN PEA V.H
	City Pt. Mart McCormack H	-	1-60	1-60	-	-	-	-	-
	Army Base-South Station	C	C	1-38	-	-	-	-	-
	Watertwon - Kenmore	14-4/5	7-9	12-7/8	13-5/6	C	C	C	C
	Chestnut Hill - Kenmore	5-20	2-35	3-28	5-20	2-30	-	C	C
	Brighton Ctr. - Kenmore	3-20	2-30	2-30	3-20	-	-	C	-
.3	Northwest Ind. - Dudley	-	-	-	1-	-	-	-	-
.2	Riverside-Fed. & Franklin	14-4	-	4-15	13-4	2-30	-	-	-
.3	Brighton Cir.Fed.&Frankln	9-6	-	4-15	9-5	-	-	-	-
	Watertwon - Copley Square	5-10	-	-	4-12	-	-	-	-
	Riverside-Copley Square	3-20	-	-	3-17	-	-	-	-
.3	Watertown-Franklin & Fed.	15-7	4-15	8-10	14-3	-	-	C	-
.1	Walth.-Fed. & Franklin	6-13	-	3-20	6-12	-	-	-	-
.1	Roberts - Newton Corner	2-60	2-60	2-60	2	-	-	-	C
.2	Waverly-Newton Corner	1-60	1-60	1-60	1-60	-	-	C	-
.2	Walth. Hld.-Newton Corner	1-60	1-60	2-20	1-60	-	-	C	-
.1	Auburndale-Newton Corner	2-30	1-60	2-60	2-35	-	-	C	-
	Framingham-Newton Corner	4-30	2-60	3-30	4-30	-	-	C	-
	Needham Sq. - Watertown	3-30	2-45	3-30	3-30	-	-	C	-
	Kennedy Lib.Columbia Shut	-	1-20	1-20	1-20	-	-	C	C
	Needham-Downtown Shuttle	19-5	2-60	4-30	18-5	2-100	1-	C	-
	Roslindale Sq.-Cop.Shuttle	3-30	-	-	3-30	-	-	-	-
	Watertown	1		1	1				
	School	1		11					
7	City Pt.-Franklin & Arch	-	3-20	3-20	-				
	TOTAL	111	31	71	107	6	1		

NOTES: H. Headway
V. Vehicles
RAD. Run as directed

LINE STATISTICS

GARAGE: ARBORWAY

DATE: WINTER 1980

		WEEKDAY						WEEKEND	
OUTE NO.	TERMINII	A.M. V.H.	BASE V.H.	2-4 V.H.	P.M. V.H.	8-10 V.H.	LATE V.H.	SAT.PEAK V.H.	SUN PEA V.H
21	Ashmont - Forest Hills	3-15	1-45	2-25	2-25	-	-	1-45	-
24	Wakefield Ave. - Mattapan	3-17	1-40	2-25	2-25	-	-	1-45	-
25	Gallivan Blvd. - Ashmont	3-12	2-20	2-20	3-12	-	-	2-20	-
26	Norfolk St. - Ashmont	2-12	1-20	2-20	2-13	-	-	1-30	-
26.1	Ashmnt-Ashmnt-Nrflk-Wash.	-	-	-	-	1-30	1-30	-	1-3
27	Mattapan - Ashmont	1-30	1-30	1-30	1-30	1-60	1-60	1-30	1-6
28	Mattapan - Arborway	2-20	-	1-30	1-30	-	-	-	-
29	Mattapan - Egleston	11-4/5	6-10	10-5	11-5	3-15	3-15	6-9	4-1
30	Mattapan - Roslindale	2-20	1-60	2-20	2-30	-60	-60	1-40	-6
31	Wolcott Sq. - Mattapan	2-17	1-40	2-25	2-25	-	-	1-40	-
31.3	Wolcott-Matt via Truman Hw	-	-	-	-	1-45	1-45	-	1-4
32	Cleary Sq. - Arborway	8-3/4	3-13	6-7	8-5	2-30	2-30	4-10	2-3
33.5	River&Milton Sts.-Mattapan	3-15	1-60	2-20	2-30	-	-	1-60	-
34	Dedham Line - Arborway	8-5	3-30	8-7	10-5	2-30	2-30	6-10	2-3
34.6	E. Walpole - Arborway	6-15	4-30	4-30	6-12	1-60	-60	1-30	-6
35	Stimson & Wash. - Arborway	4-12	2-30	4-20	5-15	-90	-90	2-30	1-9
-36.8	Charles River Loop-Arbrwy.	9-6	2-30	6-12	7-7	2-45	1-45	4-15	1-4
37	Baker & Vermont - Arborway	3-12	2-30	4-20	4-15	1-90	1-90	2-30	-9
38	Wren St.-Green St. Station	2-16	2-22	-	-	-	-	2-23	1-4
38.6	Wren St.-Forest Hills Sta.	-	-	3-15	2-22	1-40	1-40	-	-
39.7	Arborway-Brigham R.A.D.	-	-	3-20	3-20	-	-	-	-
40	Georgetown - Arborway	1-50	-30	2-25	2-25	-	-	1-50	1-4
41	Center & Eliot - Dudley	3-10	2-17	3-13	3-13	1-30	1-30	3-12	1-3
46	Heath & So. Hunt. - Dudley	1-30	1-30	1-30	1-30	1-30	-	1-30	1-3
50	Cleary Sq. - Arborway	3-18	2-30	3-20	3-20	-	-	2-30	-
51	Cleveland Circle-Arborway	5-15	2-30	6-15	6-20	1-60	1-60	2-30	-
58	Boston College-Blandford	4-13	-	-	3-20	-	-	-	-
173.1	Needham Ind. Prk-Dudley	1-X	-	-	1-X	-	-	-	-
533	Dedham Mall - Watertown	3-30	3-30	3-30	3-30	-	-	@1-60	-
595.3	Cntr&Eliot-Jm. Pln. Loop	-	1-30	1-30	-	-	-	1-30	-
	School	28	1	32					
	TOTAL	121	45	115	95	18	15	47	17

NOTES: H. Headway
V. Vehicles
@ Oak Hill - Newton Corner
X Irregular Service

LINE STATISTICS

GARAGE: BENNETT ST.

DATE: WINTER 1980

		WEEKDAY						WEEKEND	
ROUTE NO.	TERMINII	A.M. V.H.	BASE V.H.	2-4 V.H.	P.M. V.H.	8-10 V.H.	LATE V.H.	SAT.PEAK V.H.	SUN. PEA V.H.
3	Cleveland Cr.-Central Sq.	3-20	2-30	3-20	3-20	1-60	1-60	2-30	-
4.5	Oak Sq. - Central Sq.	3-20	2-30	4-15	4-15	1-60	1-60	2-30	-
9	Harvard Sq. - Lechmere	4-13	3-15	4-12	3-15	1-30	1-30	3-15	1-
1.4	Watertown-Harvard/Brattle	-	-	-	-	-	-	-	2-
2.4	Huron Ave-Harvard/Brattle	-	-	-	-	1-30	1-30	-30	1-
3.5	Waverly-Harvard/Brattle	-	-	-	-	-	-	-	2-
4.3	Belmont-Cntrl-Hrvd/Brttl	4-12	2-30	4-15	4-14	1-40	1-40	2-30	1-
5	Harvard Sq. - Kendall	2-15	1-30	1-30	1-32	-	-	-	-
7.4	Arl.Hgts-Benn-Hrvd/Brttl	31-4	11-7	17-5	25-3	9-7/8	6-10	11-8	7-
7.5	Arl. Cntr-Benn-Hrvd/Brttl	-4	-	-	-	-	-	-	-
8.5	Park Cir.-Harvard/Brattle	4-14	2-30	4-15	4-13/14	1-60	1-60	2-30	-
3.1	Rindge Ave.-Central Sq.	4-13	3-20	5-15	5-13	1-45	1-45	3-20	1-
34.3	Arlmont-Harvard/Brattle	4-17	-	4-15	5-13/14	-	-	2-30	-
35.3	Spring Hill - Kendall	2-15	1-50	2-30	2-20	-	-	1-30	-
36.6	Union Sq-Som-Union Sq-Alls	S5-15	2-30	S5-15	5-15	1-50	1-50	2-30	1-
37	Clarendon Hill - Lechmere	3-17	3-17	8-7/8	*3-15	2-30	1-40	4-15	2-
37.2	Arl-Lechmere via Somv. Ave	4-17	-	-	5-15	-	-	-	-
38	Clarendon Hill-Lechmere	10-5	3-15	5-11	7-8	2-30	1-40	3-15	1-
23.3	Cedarwood-Central Sq. Camb	6-20	4-30	6-20	6-20	1-60	1-60	4-30	1-
525.1	Lexington - Waltham	1-65	1-60	1-70	1-70	-	-	1-60	-
528.4	Arl.Hgts-Hanscom Air Base	-	-	-	-	-	-	1-60	-
528.3	Hanscom AirBase-Hrvd/Brttl	4-30	2-60	2-60	4-30	-	-	-	-
529	Arl.Hgts.-Bedf. V.A.Hosp.	2-30	1-60	2-30	3-35	-	-	1-60	-
530.5	Five Forks-Arlington Cent.	1-60	-	1-60	1-60	-	-	-	-
	School	1		16					
	TOTAL BUSES	98	43	94	91	22	17	44	20
	TRACKLESS TROLLEY								
71.2	Watertown-Harvard/Brattle	7-6	4-10	5-9	6-7/8	2-30	2-30	4-12	B
72.3	Huron Ave.-Camb. Common	3-10	1-30	3-10	3-10	-	-	1-30	B
73.2	Waverly-Harvard/Brattle	14-3/4	5-11	9-5	10-4/5	1-30	1-30	5-10	B
73.9	No. Camb.-Camb. Common	10-3	3-10	7-5	9-4	-	-	4-9	B
	TOTAL TRACKLESS TROLLEY	34	13	24	28	3	3	14	

NOTES: H. Headway
V. Vehicles
B. Sunday-Holiday Bus
* Davis Sq.-Lechmere

LINE STATISTICS

GARAGE: CHARLESTOWN

DATE: WINTER 1980

		WEEKDAY						WEEKEND	
ROUTE NO.	TERMINII	A.M. V.H.	BASE V.H.	2-4 V.H.	P.M. V.H.	8-10 V.H.	LATE V.H.	SAT.PEAK V.H.	SUN. PEAK V.H
0	Arlington Center-Lechmere	9-7/8	4-17	5-15	6-12	2-25	2-25	5-14	2-3
9	Clarendon Hill-Sullivan	6-7	3-15	4-11	8-7/8	1-40	1-40	3-15	1-3
0	Davis Sq.-Sllvn. via Hlnd	1-49	1-45	1-45	1-50	-	-	-	-
1	Sullivan Sq.-Central Sq.	5-12	3-15	3-15	3-15	1-40	1-30	2-20	1-3
2.3	Slvn.Sq.-Smr&Chncy via Mn	3-15	2-30	3-17	3-17	1-30	1-30	2-30	1-3
3.6	Sull-Smmr-Chncy,Bnkr.Hill	9-5/6	3-20	7-10	8-6/7	1-30	1-30	3-20	-3
5	West Medford - Sullivan	F	F	F	F	1-45	1-50	3-20	1-4
6.8	Mdfrd.Sq.-Benn.St. via Gr	F	F	F	F	2-40	2-40	6-15	2-4
9.9	Upper Hld.-Wellington	F	F	F	F	1-60	1-60	3-23	1-6
0.3	Elm St. - Wellington	F	F	F	F	1-35	1-35	2-20	1-3
1	Salem St. - Sullivan	F	F	F	F	1-45	1-40	6-15	2-3
4.1	Malden Sq.-Sull.via Ferry	9-8	2-30	4-20	5-12	2-25	1-45	2-30	3-3
5.1	Malden-Sull. via Faulkner	2-30	2-35	2-35	2-35	1-60	-	2-35	1-6
06	Lebanon - Wellington	F	F	F	F	1-50	1-50	4-20	2-3
08.6	Linden - Wellington	F	F	F	F	1-45	1-45	5-30	-4
09.1	Lndn-Sllvn. via Everett	7-8	2-25	3-20	5-12	1-32	1-45	2-30	-3
10.4	Brdwy&Prk Ave-Wllngtn via Woodlawn	-	-	-	-	-	-	-	1-3
11.5	Woodlawn - Haymarket Sq.	-	-	-	-	-	-	-	2-2
2.1	Bellingham - Wood Island via Central Ave.	-	-	-	-	-	-	-	1-3
16.4	Wndrlnd-Mvrk via Revere St	-	-	-	-	-	-	-	2-3
17.5	Wndrlnd-Mvrk via Beach St	-	-	-	-	-	-	-	2-3
119.3	Rvr. Cty Hl - Beachmont-Cooledge St.	-	-	-	-	-	-	-	1-4
120	O. Hts. Sta-Maverick Sta. via Jffrs. Pt. Wldmr. Ave	-	-	-	-	-	-	-	2-1
131.2	Melrose-Highland-Malden	2-30	1-X	1-60	2-30	-	-	-	-
134.7	Medford Sq. - Wellington	F	-	-	F	1-45	1-45	-	-4
135.5	Wakefield Sq.-Malden Sta.	1-60	-	1-60	2-60	1-60	-	-	1-6
136.5	Rdng-Mldn via Lakeside	2-60	2-60	1-120	1-65	-	-	2-60	-
137.3	Rdng Sq. - Malden Sta.	1-60	1-60	2-120	1-60	-	-	1-60	-
590.2	Somerville Mini Bus	-	1-70	1-80	-	-	-	1-70	-
700.2	Brlngtn Ln-Park Sq.Boston	6-15	2-60	2-60	4-25	1-60	-	2-60	1-1
701	Brlngtn Ln-Park Sq. via Woburn Sq. Interstate 93	2-75	-	-	-	-	-		
701.3	Brlngtn Ln-Copley Square	4-10	-	-	-	-	-		
701.5	Woburn Sq. - Park Sq.	2-40	-	-	-	-	-		
701.6	Burl.Ml-Pk.Sq via Wbrn Sq	3-25	-	-	-	-	-		
700.3	Burl.Ln-Pk.Sq via Mass Pk	-	-	-	2-26	-	-		
700.8	Burl.Ln-Gov. Cntr. Boston	-	-	-	1-60	-	-		
701.4	Burl.Ln-Hymk Sq via In 93	-	-	-	8-10	-	-		
701.8	Burl-Hymkt via 128	-	-	-	1-60	-	-		
	School	6		20					
	TOTAL BUSES	80	29	60	63	21	17	56	3

NOTES: H. Headway
V. Vehicles
X. Irregular Service

E. Eagle Garage
F. Fellsway Garage

GARAGE: FELLSWAY

LINE STATISTICS

DATE: WINTER 1980

		WEEKDAY						WEEKEND	
ROUTE NO.	TERMINII	A.M. V.H.	BASE V.H.	2-4 V.H.	P.M. V.H.	8-10 V.H.	LATE V.H.	SAT.PEAK V.H.	SUN. PEA V.H.
95	West Medford - Sullivan	6-12	3-20	4-15	4-15	C	C	C	C
6 7.8	Mdfrd.Sq.-Hrvrd/Brttl	10-8	6-35	6-15	11-8	C	C	C	C
97.5	Malden-Wllngtn via Comm.	2-30	1-45	1-50	2-25	-	-	-	-
99.7	Upper Highland-Wellington	5-15	2-30	3-20	3-20	C	C	-	-
100.3	Elm St. - Wellington	3-13	2-20	3-15	3-13	C	C	C	C
101	Salem St. - Sullivan	6-12	-	3-15	M3-15	C	C	C	C
101.3	Malden Sta. - Sullivan	6-12	5-15	5-15	5-15	-	-	-	-
106	Lebanon - Wellington	5-12	3-20	4-20	4-20	C	C	C	C
108.6	Linden - Wellington	5-15	2-30	4-18	4-18	C	C	C	C
134.5	No. Woburn - Wellington	2-60	2-60	2-60	2-60	-	-	C	-
134.6	Winthrop St.- Wellington	1-60	1-60	1-60	1-60	-	-	C	-
134.7	Medford Sq. - Wellington	1-30	-	-	1-30	C	C	C	C
325.1	Elm St. - Haymarket	3-13	-	-	4-12	-	-	-	-
326.1	West Medford - Haymarket	4-13	-	-	4-13	-	-	-	-
	School	5		14					
	Run as directed	1							
	TOTAL BUSES	65	27	50	51				

NOTES:
H. Headway
V. Vehicles
M. Medford Sq. - Sullivan
X. Irregular Service

LINE STATISTICS

GARAGE: EAGLE ST.

DATE: WINTER 1980

		WEEKDAY						WEEKEND	
ROUTE NO.	TERMINII	A.M. V.H.	BASE V.H.	2-4 V.H.	P.M. V.H.	8-10 V.H.	LATE V.H.	SAT.PEAK V.H.	SUN. PEA V.H
110	Wonderland - Wellington	6-18	3-20	4-20	3-25	-	-	3-20	C
110.2	Woodlawn - Wellington	-20	-	-	2-25	1-50	1-40	-	C
11.5	Woodlawn - Haymarket	11-4/5	4-15	5-12	8-7	2-35	2-25	4-15	C
2.6	Everett Sq. - Wood Island	2-30	2-30	2-30	2-30	-	-	2-30	C
5.4	Wond.-Maverick-Revere St.	4-15	4-20	4-20	3-20	1-40	2-40	7-20	C
7.5	Wond.-Maverick via Beach	4-15	3-20	3-20	4-20	2-40	1-40	-20	C
9.3	Revere Cty Hall-Beachmont	2-20	2-30	2-30	2-20	1-40	1-40	1-40	C
0	Orient Hghts-Maverick	4-13	3-20	5-15	4-15	1-50	1-50	3-20	C
1	Wd.Islnd Prk-Maverick Lex	2-15	1-30	1-30	1-20	-	-	1-30	-
	School	2	1	14					
	TOTAL BUSES	37	23	40	29	8	8	21	

NOTES: H. Headway
V. Vehicles
C. Charlestown

LINE STATISTICS

GARAGE: QUINCY

DATE: WINTER 1980

		WEEKDAY						WEEKEND	
ROUTE NO.	TERMINII	A.M. V.H.	BASE V.H.	2-4 V.H.	P.M. V.H.	8-10 V.H.	LATE V.H.	SAT.PEAK V.H.	SUN PEA V.H
20	Flds. Cor-Neponset&Adams	-10	2-20	2-20	2-20	1-30	1-30	1-30	1-3
20.1	Flds. Cor-Neponset. Belt	-	-	-	-	-	-	1-30	-
20.2	Flds. Cor-Adams & Hallett	2-20	1-20	2-15	3-10	-	-	-	-
20.7	Gal.Blvd-Flds.Cor.via Adms	3-8	-	-	-	-	-	-	-
10	Qncy-No.Quincy via Hancock	-	1-30	-	1-30	-	-	-	-
10.3	Quincy - Fields Corner	2-25	-	3-20	3-20	-	-	1-30	1-6
11	Quincy - Squantum	2-30	1-60	1-60	2-30	-	-	1-60	-1
12.2	Qncy-No.Quincy via Billing	1-60	1-60	1-60	1-60	-	-	1-60	-
14.1	Quincy - Germantown	4-8	1-40	2-20	2-20	-	-	1-40	-
15.1	Qncy-Ashmnt via W. Quincy	3-20	2-30	3-20	4-20	1-60	1-60	2-30	-1
16	Quincy - Houghs Neck	5-15	1-40	2-20	2-20	1-45	1-45	1-40	1-4
17	Wollaston - Ashmont	2-30	1-60	1-60	2-30	-	-	1-60	-1
20.1	Quincy - Hingham	6-10	2-30	2-25	5-20	1-60	1-60	2-60	-6
21	Quincy - Fort Point	1-70	-	-	-	-	-	-	-
22	Quincy - East Weymouth	4-12	2-30	2-30	4-20	1-60	1-60	2-30	1-6
25.1	Qncy Ctr-Wymth via Desmns	2-30	1-60	1-120	1-20	1-60	1-60	2-60	-1
25.4	Quincy Cntr-Weymouth Lndng	2-30	1-60	1-60	3-15	-60	1-60	-	1-1
28	Quincy Cntr-E. Braintree	1-60	1-60	1-60	-60	-	-	-60	-
30.1	Quincy Cntr-S. Braintree	-	-	-	2-30	-	-	-	-
30.3	Quincy Center-Holbrook	6-10	1-60	2-60	5-15	1-60	-	2-60	1-1
37	Qncy Ctr-S.Shore Plaza	-30	1-60	1-60	-	-	-	1-60	-
38	Quincy Center-Crawford Sq	2-27	1-60	1-60	2-30	1-60	1-60	1-60	1-1
240.1	Crawford Sq.- Ashmont	7-10	3-30	4-30	9-10	1-60	1-60	4-60	2-6
245.4	Qncy-Mattapan via E.Milton	2-30	1-60	2-30	2-30	-	-	1-60	-1
	School	12		35					
	TOTAL BUSES	69	25	69	55	9	9	25	9

NOTES: H. Headway
V. Vehicles

LINE STATISTICS

GARAGE: LYNN

DATE: WINTER 1980

		WEEKDAY						WEEKEND	
ROUTE NO.	TERMINII	A.M. V.H.	BASE V.H.	2-4 V.H.	P.M. V.H.	8-10 V.H.	LATE V.H.	SAT.PEAK V.H.	SUN PEA V.H
20	Lebanon St. - Wyoming Ave.	2-30	1-60	2-30	2-30	-	-	1-60	-
400	Lynn-Boston via Western Av	5-15	2-30	3-20	7-15	1-60	1-60	2-30	2-3
11	Linden - Revere Beach	1-30	-	1-40	1-35	-	-	-	-
11.6	Northgate - Revere House	-	1-60	-	-	-	-	1-60	-
26	Lynn-Boston via Cliftondale	8-8	1-60	2-60	10-10	1-60	1-60	1-60	1-6
28	Central Sq. - Oaklandvale	1-30	1-60	1-60	1-60	-	-	1-60	-1
29	Central Sq.-North Saugus	2-30	1-60	2-60	2-30	-	-	1-60	-
30.1	Saugus - Malden	1-60	1-60	2-40	2-40	-	-	2-40	-
30.8	Granada Hlds.-Malden Sta.	2-40	1-60	1-40	1-40	-	-	1-30	-
32	Cent.Sq.-Myrtle & Holyoke	1-30	1-60	1-60	1-30	-	-	2-30	1-1
33	Central Sq. - Pine Hill	2-30	1-60	1-60	2-30	-	-	1-60	-
35.1	Central Sq.-Lib. Tree Mall	2-60	1-60	1-60	1-60	-	-	2-60	-1
36.3	Central Sq.-Goodwin Circle	2-30	1-60	1-50	1-50	-	-	1-60	-
37	Central Sq. - Lakeside	2-30	1-60	2-30	2-30	-	-	1-30	1-6
39	Central Sq. - Nahant	-30	-180	1-30	1-35	-	-	1-60	-
40	Lynn-Boston via Lynnway	5-15	2-30	2-30	6-15	1-60	1-60	2-30	1-6
41	Lynn-Marblehead via Parad.	2-30	1-60	1-60	2-30	-	-	1-60	-
42	Lynn-Marblehead via Humph.	1-30	1-60	1-60	2-30	1-60	1-60	1-60	1-6
50	Salem-Boston via Westn Ave	9-15	1-60	1-60	9-10	1-90	-	2-60	2-9
51.5	Salem - North Beverly	1-35	1-60	1-60	2-30	-	-	1-60	-
55	Salem - Lynn via Loring	2-30	2-30	2-30	2-30	1-60	1-60	3-30	1-6
56.1	Central Sq. - Fay's Estate	2-30	1-X	-	2-30	-	-	-	-
458.2	Salem Centre-Danvers Sq.	1-	1-120	1-50	1-50	-	-	-	1-1
462.3	Salem - Salem Hosp. Loop	-	-180	-	-	-	-	-	-
468.4	Salem - Danvers Hosp.	1-X	-	-	1-X	-	-	-	-
	SCHOOL	12		18					
	TOTAL BUSES	67	24	48	61	6	5	28	1

NOTES:
H. Headway
V. Vehicles
W. Lynn to Wonderland Shuttle
X. Irregular Headway

LINE STATISTICS

GARAGE: RAIL LINES

DATE: WINTER 1980

		WEEKDAY						WEEKEND	
ROUTE NO.	TERMINII	A.M. V.H.	BASE V.H.	2-4 V.H.	P.M. V.H.	8-10 V.H.	LATE V.H.	SAT.PEAK V.H.	SUN PEA V.H
	RESERVOIR STATION								
10	Bos.Coll.Lechmere-Comm. Ave.	18T-5/6	-	18T-6	19T-6	-	-	14T-7	-
12	Bos.Coll.Gov't Cntr via Comm.	-	13T-7	-	-	11S-8	10S-10	-	10S-
0	Cleveland Cir.-Lechmere	13T-7	13T-7	13T-7	14T-7	8S-10	8S-10	13T-7	8S-
1	Riverside - North Station	15T-8	10T-10	16T-7	16T-7/8	10S-10	10S-10	18S-6	13S-
	Boston College R.A.D.								2S
	Riverside R.A.D.								1S
(L)	Northeastern R.A.D.	4S	4S	4S	4S	2S	2S	3S	-
7 Ⓑ	Blandford - R.A.D.	3S	3S	3S	3S	-	-	3S	-
	TOTAL CARS	99	79	101	105	31	30	78	3
	ARBORWAY STATION								
33	Heath St. - Park St.	8S-8	-	5S-12	5S-12	-	-	-	-
93	Arborway - Park St.	14T-6	10T-8	13T-8	13T-8	9S-9	6S-12	10T-9	11S-
	TOTAL CARS	36	20	31	31	9	6	20	1
	MATTAPAN STATION								
99	Mattapan - Ashmont	9S-3	3S-8	5S-5	7S-4	2S-15	2S-15	3S-8	2S-
	TOTAL CARS	9	3	5	7	2	2	3	
	ORANGE LINE								
1-902	Oak Grove - Forest Hills	16F-5	9F-8/8/9	9F-8/8/9	16F-5	5T-15	5T-15	9F-8/9	5T
	TOTAL CARS	64	36	36	64	10	10	36	1
	RED LINE								
35-936	Harvard/Brattle-Ashmont	11F-6/7	7F-10	7F-10	12F-6	4T-17	4T-17	9T-7/8	4T-
37-938	Harvard / Brattle - Quincy	11F-6/7	7F-10	7F-10	12F-6	4T-17	4T-17	9T-7/8	4T-
	TOTAL CARS	88	56	56	96	16	16	36	1
	BLUE LINE								
6-47	Wonderland - Bowdoin	10F-5	6F-7/8	6F-7/8	11F-4/5	5T-11	4T-11	6F-7½	6T
	TOTAL CARS	40	24	24	44	10	8	24	1

NOTES:	
H. Headway	S-Single Car
V. Vehicles	T-Two Cars
RAD. Run as directed	K-Three Cars
	F-Four Cars

LINE STATISTICS

GARAGE: VEHICLE RECAP

DATE: WINTER 1980

		WEEKDAY						WEEKEND	
ROUTE NO.	TERMINII	A.M. V.H.	BASE V.H.	2-4 V.H.	P.M. V.H.	8-10 V.H.	LATE V.H.	SAT.PEAK V.H.	SUN PEA. V.H
	BUSES								
	Albany	111	31	71	107	6	1	-	-
	Cabot	127	60	110	109	33	31	94	47
	Arborway	121	45	115	95	18	15	47	17
	Somerville	98	43	94	91	22	17	44	20
	Fellsway	65	27	50	51	-	-	-	-
	Charlestown	80	29	60	63	21	17	56	35
	Eagle St. *	37	23	40	29	8	8	21	
	Lynn	67	25	48	61	6	5	28	11
	Quincy	69	25	69	55	9	9	25	9
	Total *	778	308	659	661	123	103	315	139
	Trackless Trolley (Total)	34	13	24	28	3	3	14	
	STREET CARS								
	Reservoir #	99	79	101	105	31	30	78	34
	Arborway	36	20	31	31	9	6	20	11
	Mattapan	9	3	5	7	2	2	3	2
	Total Street Cars	144	102	137	143	42	38	101	47
	Rapid Transit Lines								
	Orange Line	64	36	36	64	10	10	36	10
	Red Line #	88	56	56	96	16	16	36	16
	Blue Line #	40	24	24	44	10	8	24	12
	Total Rapid Transit	192	116	116	204	36	34	96	38

NOTES: H. Headway
V. Vehicles
* 2-4 Hour is Peak
# P.M. is Peak

LINE STATISTICS

GARAGE: CABOT

DATE: SPRING 1982

		WEEKDAY						WEEKEND	
ROUTE NO.	TERMINALS	A.M. V.H.	BASE V.H.	2-4 V.H.	P.M. V.H.	8-10 V.H.	LATE V.H.	SAT PEAK V.H.	SU PE V.
01.3	Harvard - Dudley	11-6	7-9	11-7	12-6/7	4-15	3-20	7-11	4-1
06&06.2	Army Base-So Station&Haymarket	3-15	-	3-15	3-15	-	-	-	-
07	City Point-Franklin & Arch	4-12	A	1-X	3-15	1-40	-	2-30	-
08.7	Columbia Point - Dudley	2-22	2-30	2-30	2-30	1-40	1-40	1-60	1-6
09.4	City Point & Copley + 09	7-8	4-15	7-10	7-9	1-40	1-40	3-15	1-4
10	City Point - Dudley	3-20	1-60	2-30	3-22	1-50	1-50	1-60	-
11.8	City Point-Essex & Wash via Bay View	10-6	4-15	9-8	9-8	1-40	1-37	5-12	1-4
15	Kane Square - Dudley	4-7/8	2-15	3-12	4-9	1-38	1-40	3-10	1-6
16	Franklin Park - Andrew	2-17	1-30	2-17	2-17	1-30	1-30	2-22	1-6
17	Fields Corner - Andrew	3-14	1-45	4-12	4-12	-	-	2-22	-
18	Ashmont - Andrew	1-60	1-60	1-60	1-60	-	-	-	-
19	Fields Corner-Dudley Station	2-20	-	-	2-20	-	-	-	-
22	Ashmont-Dudley via Talbot	7-8	4-13	5-11	6-9	3-22	2-30	5-10	2-3
23	Ashmont-Dudley via Washington	9-6	4-13	7-7/8	7-7/8	3-20	1-30	5-10	1-3
43.1	Egleston-Park & Tremont	8-8	5-12	7-9	8-8	1-60	1-50	4-14	1-5
44	Seaver & Dudley	2-12	1-24	3-12	3-9	1-30	1-30	1-24	-6
45.1	Franklin Park - Dudley	4-8	3-12	4-10	4-10	1-30	1-30	3-12	-6
47.2	Central Square - Cambridge - Boston City Hospital	8-10	4-20	7-12	7-12	2-30	1-60	4-20	1-6
49.7	Northampton-Essex & Wash	1-50	1-50	1-50	1-50	-	-	1-50	-
55	Queensberry - Copley	1-25	1-30	1-30	1-30	1-30	1-30	1-30	1-3
57	Watertown - Kenmore	A	A	A	A	4-15	4-15	9-7/8	4-1
60	Chestnut Hill - Kenmore	A	A	A	A	1-60	1-45	2-30	1-6
65	Brighton Center - Kenmore	A	A	A	A	-	-	2-30	-
66	Allston - Dudley	8-7/8	4-15	8-10	8-8/9	2-28	1-60	5-12	1-6
68.1	City Hospital - Copley	1-30	1-30	1-30	1-35	-	-	-	-
304.3	Watertown-Federal&Franklin	A	A	A	A	-	-	4-15	-
310	Needham Jct-Federal&Franklin	A	A	A	A	-	-	2-60	-
520.1	Roberts & Newton Corner	A	A	A	A	-	-	2-60	-
521.2	Waverley - Newton Corner	A	A	A	A	-	-	1-60	-
522.2	Waltham Hld - Newton Corner	A	A	A	A	-	-	1-60	-
527.1	Auburndale - Newton Corner	A	A	A	A	-	-	1-60	-
532	Needham Junction-Watertown	A	A	A	A	-	-	2-45	-
	Schools	5							
R.A.D.	Run as Directed Dudley Lower	1-X	-	-	-	-	-	-	-
	TOTAL	107	51	89	98	30	23	81	21

NOTES:
H. Headway
V. Vehicles
A. Operated from Albany
X. Irregular Service

GARAGE: ALBANY

LINE STATISTICS

DATE: SPRING 1982

		WEEKDAY						WEEKEND	
ROUTE NO.	TERMINALS	A.M. V.H.	BASE V.H.	2-4 V.H.	P.M. V.H.	8-10 V.H.	LATE V.H.	SAT PEAK V.H.	SU PE V.
05	City Pt - Mary McCormack H.	-	1-60	1-60	-	-	-	-	-
07	City Point-Franklin & Arch	-	3-20	3-20	1-X	-	-	-	-
57	Watertown - Kenmore	11-6	7-9	11-8	12-6	C	C	C	C
60	Chestnut Hill - Kenmore	5-20	2-30	3-16	5-25	2-30	C	C	C
65	Brighton Center - Kenmore	3-20	2-30	3-23	3-25	C	C	C	C
70.3	Northwest Ind - Dudley	1-30	-	-	1-X				
300.2	Riverside-Federal & Franklin	13-4	-	1-30	13-3/4				
301.3	Brighton Ctr-Federal & Frank	9-6	-	-	2-20				
301.4	Brighton Ctr-Federal & Frank	-	-	3-15	6-5				
302.1	Watertown - Copley Square	4-12	-	1-X	4-12	-	-	-	-
304.3	Watertown-Federal & Franklin	15-7/8	4-15	6-10	13-4	-	-	C	-
305	Waltham - Federal & Franklin	8-10	-	4-20	8-10	-	-	-	-
310	Needham Jct-Federal & Frank	20-5	2-60	3-30	18-5	1-100	1-X	C	-
315	Roslindale Sq-Copley Shuttle	3-30	-	-	3-30	-	-	-	-
520.1	Roberts - Newton Corner	2-40	2-60	2-60	1-60	-	-	C	-
521.2	Waverley-Newton Corner	1-60	1-60	1-60	2-60	-	-	C	-
522.2	Waltham Hld-Newton Corner	1-60	1-60	2-30	1-60	-	-	C	-
527.1	Auburndale - Newton Corner	1-60	1-60	1-60	1-70	-	-	C	-
532.1	Needham Junction-Watertown	3-30	3-30	3-30	3-30	-	-	C	-
	Schools			3					
	TOTAL	100	29	51	97	3	1		

NOTES: H. Headway
V. Vehicles

GARAGE: ARBORWAY

LINE STATISTICS

DATE: SPRING 1982

		WEEKDAY						WEEKEND	
ROUTE NO.	TERMINALS	A.M. V.H.	BASE V.H.	2-4 V.H.	P.M. V.H.	8-10 V.H.	LATE V.H.	SAT PEAK V.H.	SU PE V.
21.1	Ashmont-Forest Hills	2-22	1-45	2-25	2-25	-	-	-	-
24	Wakefield Ave - Mattapan	2-20	1-40	2-25	2-25	1-60	1-60	1-40	-
26.1	Ashmont-Ashmont-Norfolk-Wash	4-9	1-30	2-15	4-15	1-30	1-30	2-15	-
27	Mattapan - Ashmont	1-30	1-30	1-30	1-30	-30	-30	1-30	-
29	Mattapan - Egleston	10-5	5-12	8-8	10-5	3-15	3-15	5-10	2-
30.1	Mattapan - Roslindale	2-20	1-30	2-20	2-20	1-60	1-60	1-40	-
32	Cleary Square - Arborway	7-6/7	-20	-20	7-6/7	-60	-60	-13	-
32.1	Wolcott Square - Arborway	-20	3-20	5-20	-20	1-60	1-60	4-13	1-
33.5	River & Milton St - Mattapan	2-30	1-60	2-30	2-30	-	-	1-60	-
34	Dedham Line - Arborway	7-7	3-30	4-15	10-6	-60	-60	6-10	-
34.7.8	East Walpole - Arborway	9-15	4-30	4-30	6-15	1-60	1-60	1-30	1-
35.1	Stimson & Wash - Arborway	3-18	2-30	2-30	4-12	-60	-	1-60	-
36.8	Charles River Loop-Arborway	6-9	2-30	2-30	5-12	1-60	1-60	4-15	1-
37	Baker & Vermont - Arborway	3-18	2-30	2-30	4-12	-	-	2-30	-
38.3	Wren St-Forest Hills Station	2-22	1-40	2-22	2-22	-	-180	1-40	-
39	Arborway - Copley Square	27-3	13-5	21-4	21-4	6-10	3-30	13-5	5-
40	Georgetown - Arborway	1-50	-30	2-25	2-25	-	-	1-50	-
41	Center & Eliot - Dudley	3-12	1-34	2-20	2-20	1-30	-	1-35	-
42.1	Arborway-Dudley via Wash St	2-20	2-20	2-20	2-20	1-40	-	2-20	-
46	Heath & So Huntington-Dudley	1-30	1-30	1-30	1-30	-	-	1-30	-
48	Center & Eliot-Jamaica Plain Loop	-	1-30	1-30	-	-	-	1-30	-
50	Cleary Square - Arborway	2-25	1-60	2-25	2-25	-	-	1-60	-
51	Cleveland Circle - Arborway	4-18	1-60	4-18	4-18	1-120	-	1-60	-
52.1.2	Dedham Mall - Watertown	3-30	2-45	2-45	2-45	-	-	@ 1-60	-
	Schools	17		27					
	TOTAL	120	50	104	97	18	12	52	10

NOTES: H. Headway
V. Vehicles
@. Oak Hill - Newton Center
X. Irregular Service

LINE STATISTICS

GARAGE: BENNETT

DATE: SPRING 1982

		WEEKDAY						WEEKEND	
ROUTE NO.	TERMINALS	A.M. V.H.	BASE V.H.	2-4 V.H.	P.M. V.H.	8-10 V.H.	LATE V.H.	SAT PEAK V.H.	SU PE V.
63	Cleveland Circle-Central Sq	3-20	2-30	3-20	3-20	1-60	1-60	1-60	-
64.5	Oak Square - Central Square	3-20	2-30	3-20	3-20	-	-	1-60	-
69	Harvard Sq - Lechmere	2-20	2-20	3-15	3-15	-60	-60	2-20	-
71.4	Watertown - Harvard/Brattle	6-7/8	3-15	4-11	6-7/8	2-30	2-30	3-15	1-
73.5	Waverley - Harvard/Brattle	-	-	-	-	1-30	1-30	3-15	1-
74.3	Belmont Ctr-Harvard/Brattle	3-15	2-30	4-15	4-13/14	1-60	1-40	2-30	-6
77.4	Arl Hts - Harvard/Brattle	27-3	7-10	12-6	22-4	7-10	6-12	12-7	3-
77.5	Arl Center - Harvard/Brattle	-	-	-	-	-	-	-	-
77.7	North Camb - Harvard/Brattle	-	-	-	-	-	-	-	-
78.5	Park Circle - Harvard/Brattle	4-14	-	2-15	4-15	-	-	-	-
78.6	Arlmont-Harv/Bra via Park Cir	-	2-30	2-30	-	1-60	1-60	2-30	1-6
83.1	Rindge Ave - Central Square	6-10	2-30	4-15	5-13	1-60	1-60	2-25	1-
84.3	Arlmont-Harv/Bra via Park Cir	4-17	-	3-25	4-20	-	-	-	-
85	Spring Hill - Kendall	1-30	1-40	1-40	1-40	-	-	-	-
86.6	Sull Sta-Union Sq All via Harv Square	5-15	3-30	5-15	5-15	1-60	1-60	2-35	-
87	Clarendon Hill - Lechmere	5-11	2-20	4-15	5-11	1-60	1-60	2-20	1-6
88	Clarendon Hill - Lechmere	11-5/6	3-20	4-15	7-8	1-60	1-60	3-20	-6
523.2	Lexington & Trapello/Cent Camb	-	-	-	-	-	-	2-60	-
523.3	Cedarwood - Central Sq. Camb	5-20	4-30	6-20	6-20	1-60	1-60	2-60	-6
525.1	Lexington - Waltham	1-65	1-65	1-70	1-70	-	-	-	-
528.3	Hanscom Air Base - Harv/Bra	5-30	2-60	2-60	4-30	-	-	-	-
528.4	Hanscom Air Base - Arl Heights	-	-	-	-	-	-	1-60	-
529	Arl Heights-Bedford V.A. Hos	1-60	1-60	1-60	2-60	-	-	1-60	-
530.5	Five Forks - Arlington Center	1-60	-	1-60	1-65	-	-	-	-
	Schools	3		17					
	TOTAL	96	39	82	86	18	17	41	9
	TRACKLESS TROLLEY								
72.3	Huron Ave-Camb/Common	2-15	1-30	1-30	2-15	-	-	-	-
73.2	Waverley - Harvard/Brattle	11-4	3-15	4-11	10-4/5	B	B	B	B
73.9	No Camb - Camb/Common	6-5	3-10	4-9	5-7	-	-	B	-
	TOTAL TRACKLESS TROLLEY	19	7	9	17				

NOTES:
H. Headway
V. Vehicles
B. Bus instead of T.T.

GARAGE: CHARLESTOWN

LINE STATISTICS

DATE: SPRING 1982

		WEEKDAY						WEEKEND	
ROUTE NO.	TERMINALS	A.M. V.H.	BASE V.H.	2-4 V.H.	P.M. V.H.	8-10 V.H.	LATE V.H.	SAT PEAK V.H.	S P V
80	Arlington Center - Lechmere	7-10	3-22	5-12	6-12	1-60	1-60	3-22	1-
89	Clarendon Hill - Sullivan	7-4	2-30	4-15	8-8	1-60	1-60	2-30	1-
90	Davis Sq-Wellington via Assembly Mall	-	1-60	1-60	1-60	1-60	-	1-60	-
91	Sullivan Sq-Central Square	4-12	3-20	3-15	3-15	1-60	1-60	2-20	-
92.3	Sull-Franklin & Wash via Main	3-15	2-30	2-15	3-15	1-60	-	2-30	-
93.6	Sull-Franklin&Wash via Bunker Hill	9-6	3-20	3-15	8-7	2-30	-60	3-20	1-
95	West Medford - Sullivan	F	F	F	F	1-60	1-60	1-60	-
96.8	Med-Harv/Bra via George St	F	F	F	F	2-60	1-60	5-20	1-
99.9	Upper Highland - Wellington	F	F	F	F	1-60	-	2-30	1-
100.3	Elm Street - Wellington	F	F	F	F	-60	1-60	1-30	1-
101.4	Salem Street - Sullivan	F	2-30	F	F	1-60	-60	2-30	1-
104.1	Malden Sq-Sullivan via Ferry	4-13	3-20	4-20	4-15	1-60	1-60	2-30	-
105.1	Malden-Sull via Faulkner	2-30	1-60	1-60	2-35	-	-	1-60	-
106	Lebanon-Well via Malden Sta	F	F	F	F	1-60	1-60	3-22	-
108.6	Linden-Well via Malden Sta	F	F	F	F	1-60	1-60	3-30	-
109.1	Linden-Sull via Everett	4-13	3-20	3-20	4-15	1-60	1-60	1-30	1-
110	Wonderland-Well via Woodlawn	5-14	2-30	3-20	5-15	1-60	1-60	2-30	-
111.5	Woodlawn - Haymarket Square	10-5	3-20	5-7/8	9-6	1-60	1-60	3-20	1-
112.6	Everett Sq Wood Island via Mystic Mall	1-45	1-60	1-60	1-60	-	-	1-60	-
131.1	Melrose -Highland - Malden	2-30	1-X	1-60	2-30	-	-	-	-
131.2	Melrose-Highland-Mal via Main	-	-	1-X	-	-	-	-	-
131.4	Main&Porter-Mal Sta via E Side	-	-	-	1-X	-	-	-	-
134.7	Medford Square - Wellington	F	-	-	F	1-60	1-60	2-30	1-
135.5	Wakefield Sq - Malden Station	1-60	-30	1-105	3-30	-	-	-30	-
136.5	Reading-Malden via Lakeside	2-60	2-60	1-60	1-65	-	-	2-60	-
137.3	Reading Square-Malden Station	1-60	1-60	2-75	-	-	-	-	-
137.4	Reading Sq-Mal Sta via Am Mut	-	-	-	-X	-	-	-	-
700	Burlington - Haymarket	7-10	2-60	4-45	5-25	1-120	1-120	1-60	1-
700.9	Burlington-Arlington Center	1-X	-	1-X	-	-	-	-	-
701	Burl Line-Park Sq via Wob Sq & I-93	2-75	-	-	-	-	-	-	-
701.1	Burl Line-Park Sq Mass Pike	-	-	-	2-26	-	-	-	-
701.2	Woburn Sq-Haymarket via I-93	1-X	-	-	1-X	-	-	-	-
701.3	Burl Line-Copley via 128&I-93	5-10	-	-	-	-	-	-	-
701.4	Burl Line-Haymarket via I-93	-	-	1-X	9-10	-	-	-	-
701.5	Woburn Square - Park Square	2-30	-	-	-	-	-	-	-
701.7	Burl Mall-Haymarket 128&I-93	2-X	-	-	-	-	-	-	-
701.8	Burlington-Haymarket via 128	-	-	-	1-X	-	-	-	-
701.9	Burl Industrial-Hay 128&I-93	1-X	-	1-X	-	-	-	-	-
	Schools	10		16					
	TOTALS	93	35	64	79	20	14	45	11

NOTES: H. Headway
V. Vehicles
F. Fellsway

GARAGE: FELLSWAY

LINE STATISTICS

DATE: SPRING 1982

		WEEKDAY						WEEKEND	
ROUTE NO.	TERMINALS	A.M. V.H.	BASE V.H.	2-4 V.H.	P.M. V.H.	8-10 V.H.	LATE V.H.	SAT PEAK V.H.	SU PE V.
95	West Medford-Sullivan	5-12	2-30	3-20	3-20	C	C	C	C
96.7.8	Medford Sq.-Harvard/Brattle	10-8	3-30	8-15	11-8	C	C	C	C
97.5	Malden - Wellington via Comm.	1-50	1-50	1-50	1-50	-	-	-	-
99.7	Upper Highland-Wellington	4-15	2-30	3-20	3-20	C	C	-	-
100.3	Elm St-Wellington	2-20	2-20	2-20	2-20	C	C	C	C
101	Salem Street - Sullivan	4-15	-	-	-	C	C	C	C
101.3.4	Malden Station - Sullivan	4-15	-	6-13	9-8	-	-	-	-
106	Lebanon - Wellington	4-15	2-30	4-20	4-20	C	C	C	C
108.6	Linden - Wellington	3-23	2-30	4-20	3-20	C	C	C	C
134.5	No. Woburn - Wellington	2-60	2-60	1-60	2-60	-	-	C	-
134.6	Winthrop St- Wellington	1-60	1-60	1-60	1-60	-	-	C	-
134.7	Medford Sq - Wellington	1-30	-	-	1-30	C	C	C	C
325.1	Elm St - Haymarket	3-13	-	2-15	4-15	-	-	-	-
326.1	West Medford - Haymarket	4-13	-	2-15	4-15	-	-	-	-
RAD	Run as Directed	-	-	1-X	-	-	-	-	-
	Schools	10		14					
	TOTAL	58	17	52	48				

NOTES: H. Headway
V. Vehicles
C. Charlestown

LINE STATISTICS

GARAGE: QUINCY

DATE: SPRING 1982

		WEEKDAY						WEEKEND	
ROUTE NO.	TERMINALS	A.M. V.H.	BASE V.H.	2-4 V.H.	P.M. V.H.	8-10 V.H.	LATE V.H.	SAT PEAK V.H.	SU PE. V.
20	Fields Corner-Neponset & Adams	-	1-30	1-30	1-30	1-30	1-30	1-30	1-6
20.2	Fields Corner-Adams & Hallett	-	-	-	2-15	-	-	-	-
20.4	Fields Corner - Hallett	1-30	-	-	-	-	-	-	-
20.7	Gall Blvd-Fields Cor via Adams	2-12	-	-	-	-	-	-	-
20.9	Fields Cor-Fields Cor via Adam	-	1-30	2-30	-	-	-	1-30	-
210	Quincy-No Quincy via Hancock	-	1-30	-	-	-	-	1-30	-
210.3	Quincy - Fields Corner	2-30	-	2-30	2-30	-	-	-	-
211	Quincy - Squantum	2-30	1-60	2-30	2-30	-	-	1-60	-
212.2	Quincy Station-No Quincy	-30	-60	-30	-60	-	-	-60	-
214.1	Quincy - Germantown	4-10	1-30	3-20	2-20	-	-	1-30	-
215.1	Quincy-Ashmont via W. Quincy	3-20	2-30	3-30	4-30	1-60	1-60	2-30	1-6
216.2	Quincy - Houghs Neck	4-10	2-30	3-20	2-20	1-60	1-60	2-30	1-6
217	Wollaston - Ashmont	2-30	1-60	1-60	2-30	-	-	1-60	-
220	Quincy Center Sta-Hingham	-	1-60	-	-	1-60	1-60	1-60	-1
220.1	Quincy - Hingham	6-10	1-60	3-20	7-10	-	-	1-60	-
221	Quincy - Fort Point	-X	-	-X	1-X	-	-	-	-
222	Quincy - East Weymouth	6-11	2-30	4-30	6-10	1-60	1-60	2-30	-1
225.1	Quincy-Wey via Desmoines	9-20	1-60	3-20	3-20	1-60	1-120	1-60	1-1
225.4	Quincy Cent-Weymouth Landing	-20	1-60	2-20	2-20	-	-	1-60	-
230.3	Quincy Center-Brockton Line via Braintree Sta.	4-20	2-60	2-60	4-20	1-60	1-60	2-60	-1
236.2	Quincy Center-South Shore Plaza via Braintree Sta.	1-60	2-60	2-60	3-30	-	-	1-60	-
238	Quincy Cent-Crawford Square	3-30	1-60	1-60	3-30	1-60	1-60	2-60	-1
240.1	Crawford Square-Ashmont	6-10	2-30	3-30	6-10	1-60	1-60	2-60	1-1
245.4	Quincy-Mattapan via E. Milton	2-30	1-60	1-60	3-30	-	-	1-60	-
	Schools	12		19					
	TOTAL	69	24	57	55	9	9	24	5

NOTES: H. Headway
V. Vehicles
X. Irregular Service

GARAGE: LYNN

LINE STATISTICS

DATE: SPRING 1982

		WEEKDAY						WEEKEND	
ROUTE NO.	TERMINALS	A.M. V.H.	BASE V.H.	2-4 V.H.	P.M. V.H.	8-10 V.H.	LATE V.H.	SAT PEAK V.H.	SU PE V.
116.4	Wonderland-Marverick-Revere St	5-15	3-30	4-20	4-20	1-60	1-60	3-30	-6
117.5	Wonderland-Maverick via Beach	4-15	2-30	3-20	3-20	1-60	1-60	2-30	-6
119.3	Revere City Hall - Beachmont	2-30	1-60	2-30	2-30	1-40	-	1-60	-
120	Orient Heights - Maverick	4-14	3-20	4-15	4-15	1-60	1-60	2-30	-6
121	Wood Island - Maverick	1-30	-	-	1-25				
130	Melrose-Lebanon-Wyoming Sq. via Malden Square	2-30	-60	2-30	2-30	-	-	1-60	-
181	Wonderland-Orient Hts Shuttle						-25		
400	Lynn-Boston via Western Ave	5-15	3-30	3-30	6-15	1-60	1-60	3-30	1-6
411.6	Northgate - Revere House	-	1-60	-	-				
426	Lynn-Boston via Cliftondale	12-8	2-60	4-30	11-10	1-80	1-80	2-60	1-1
429.1	Cent Sq-No Saugus via Myrtle	2-30	1-60	2-30	2-30	-	-	1-60	-
430.1	Saugus - Malden	2-35	1-60	2-45	2-45	-	-	1-60	-
430.8	Granada Hlds - Malden Station	1-35	1-60	1-40	1-40				
433	Central Square - Pine Hill	2-30	-	-	1-40				
435.2	Central Sq-Danvers Sq via Mall	-	2-60	2-60	1-60	-	-	2-60	-
436.3	Central Sq - Goodwin Circle	2-30	1-60	2-30	2-30	-	-	1-60	-
437.1	Cent Sq - Lakeside via Eastern	2-30	1-60	2-30	2-30	-	-	1-60	-
439	Central Square - Nahant	1-30	-	-	1-40				
440	Lynn-Boston via Lynnway	7-15	2-30	3-30	7-15	1-60	1-60	2-30	-
441	Lynn-Marblehead via Paradise	2-30	1-60	1-60	2-30	-	-	1-60	-
442	Lynn-Marblehead via Humphrey	2-30	1-60	1-60	2-30	1-60	1-60	1-60	1-1
450	Salem-Boston via Western Ave	11-15	2-60	1-60	10-10	1-90	-	2-60	1-1
451.5	Salem - North Beverly	1-60	1-60	1-60	1-60	-	-	1-60	-
455	Salem - Lynn via Loring Ave	2-30	2-30	2-30	2-30	1-60	1-60	2-30	-1
458.1	Salem - Danvers Square	1-X	1-60	1-50	1-50	-	-	-	-
458-4	Salem - Danvers Hospital	1-60		1-X	1-X				
RAD	Run as Directed	1-X			1-X				
	Schools	6		10					
	TOTAL	81	32	54	72	10	8	29	6

NOTES: H. Headway
V. Vehicles

LINE STATISTICS

GARAGE: RAIL LINES

DATE: SPRING 1982

		WEEKDAY						WEEKEND	
ROUTE NO.	TERMINALS	A.M. V.H.	BASE V.H.	2-4 V.H.	P.M. V.H.	8-10 V.H.	LATE V.H.	SAT PEAK V.H.	SU PE V.
	RESERVOIR STATION								
311	Boston College-North Station	30S-3/4	20S-5	30S-3/4	30S-3/4	10S-10	10S-10	20S-5	9
333	Cleveland Circle - Park Street	14T-6	8T-10	14T-6	14T-6	7S-10	5S-10	8T-10	8
350	Riverside - Lechmere	17T-6/7	11T-10	15T-7/8	15T-7/8	11S-10	11S-10	11T-10	11
NBL)	Northeastern R.A.D.	6S	8S	8S	6S	4S	4S	6S	
(B)	Blandford - R.A.D.	-	-	-	4S	4S	4S	4S	4
	Riverside - R.A.D.	-	-	-	-	-	-	-	1
	Boston College - R.A.D.	-	-	-	-	-	-	-	2
	TOTAL CARS	98	66	96	98	36	34	68	35
	ARBORWAY STATION	Buses are replacing Rail Service on Arborway Line							
	MATTAPAN STATION								
399	Mattapan - Ashmont	6S-4	3S-8	5S-5	6S-4	2S-12	2S-12	3S-8	2
	TOTAL CARS	6	3	5	6	2	2	3	2
	ORANGE LINE								
01-02	Oak Grove - Forest Hills	18F-4	10F-7/8	10F-7/8	18F-4	6T-12	6T-12	10F-7/8	7
	TOTAL CARS	72	40	40	72	12	12	40	14
	RED LINE								
35-36	Harvard/Brattle - Ashmont	12F-6	7F10/11	7F10/11	12F-6	6T-12	6T-12	7F-10	6
RAD	Run as Directed	1F-X			1F-X				
39-40	Harvard/Brattle- Braintree	14F-6	8F10/11	8F10/11	14F-6	7T-12	7T-12	8F-10	7
RAD	Run as Directed	2J-X			1J-X				
	TOTAL CARS	118	60	60	113	26	26	60	26
	BLUE LINE								
946-47	Wonderland-Gov't Center	11F-4	6F7/8	6F7/8	11F-4	5T-11	4T-11	6F-7/8	4
	TOTAL CARS	44	24	24	44	10	8	24	8

NOTES:	
H. Headway	S-Single Car
V. Vehicles	T-Two Cars
X. Irregular Headway	K-Three Cars
	F-Four Cars
	J-Five Cars

LINE STATISTICS

GARAGE: VEHICLE RECAP

DATE: SPRING 1982

		WEEKDAY						WEEKEND	
ROUTE NO.	TERMINALS	A.M. V.H.	BASE V.H.	2-4 V.H.	P.M. V.H.	8-10 V.H.	LATE V.H.	SAT PEAK V.H.	SUN PEAK V.H.
	Albany	100	29	51	97	3	1	-	-
	Cabot	107	51	89	98	30	23	81	21
	Arborway *	120	50	104	97	18	12	52	10
	Somerville	96	39	82	86	18	17	41	9
	Fellsway	58	17	52	48	-	-	-	-
	Charlestown	93	35	64	79	20	14	45	11
	Lynn	81	32	54	72	10	8	29	6
	Quincy	69	24	57	55	9	9	24	5
	TOTAL	724	277	553	632	108	84	272	62
	Trackless Trolley (Total)	19	7	9	17				
	STREET CARS								
	Reservoir	98	66	96	98	36	34	68	35
	Arborway *	-	-	-	-	-	-	-	-
	Mattapan	6	3	5	6	2	2	3	2
	TOTAL STREET CARS	104	69	101	104	38	36	71	37
	RAPID TRANSIT LINES								
	Orange Line	72	40	40	72	12	12	40	4
	Red Line	118	60	60	113	26	26	60	26
	Blue Line	44	24	24	44	10	8	24	8
	TOTAL RAPID TRANSIT	234	124	124	229	48	46	124	48

NOTES: H. Headway
V. Vehicles
*. Buses Replacing Rail Service

PLANS & SCHEDULES DEPT.

APPENDIX C - 3 : Estimated Theoretical Operating Capacities and Estimates for Normal and Crush Capacities.

APPENDIX C - 3: Operating Capacities

The theoretical operating capacity of a rail transit system, defined as the number of passenger spaces provided through a given point during a specified period of time, is dependent upon the size of the transit cars and the train length, the schedule these trains adhere to, and the operation variance from the schedule. Thus, in computing line capacity, three major areas have been addressed:

- Train Capacity: length of train and car capacity.
- Schedule
- Operations

Train Capacity. Train capacity is computed by multiplying train car constraint (number of cars per train) by car capacity.

- Length of train: The maximum number of cars per train is constrained by the platform length. Currently, platforms are of sufficient length on all of the MBTA rapid rail lines to accommodate 4-car trains. On the Orange and Red Lines, the station spacing is sufficient to permit lengthening of platforms to accommodate 6-car trains.

- Car capacity: Is calculated by adding the number of seats to the number of standee spaces. Standee spaces are computed by dividing the floor space available for standing by the space per standee. Different measures have been used for space per standee with the ultimate choice one of policy and judgement. Figures used in the past have ranged from 2.5 square feet to 1.5 square feet per standee. 2.5 square feet generally reflects a comfortable amount of standing room with sufficient area to move unhindered into and out of a vehicle. At loadings greater than this, passengers may have difficulty boarding a vehicle. One and one-half square feet has been used as a design load; that is, the equipment has been designed to accommodate the weight of passengers if there were one on every 1.5 square feet of available floor space. Observations of the maximum or "crush" load on transit vehicles indicates that 1.75 square feet most reasonably reflects the maximum standing capacity of a vehicle. For the purpose of these estimates, 2.5 square feet per standee has been used to reflect a "normal" load and 1.75 square feet has been used to reflect a "crush" load.

Schedule. To compute line capacity requires multiplication of train capacity times the number of trains passing one point on the line in a given period of time.

- Frequency: The schedule is constrained by the maximum frequency at which trains can be operated. This is determined by signal system design and the tolerances for operating variances from schedule. The signal system for each of the MBTA's rapid rail lines is designed to accommodate trains at 90-second intervals.

However, scheduling trains at 90-second intervals would provide no room for variance from the schedule which normally occurs. Also, the time spent loading and unloading passengers can vary from train to train depending upon the flow of passengers through the system.

It is estimated that the variance from scheduled headway can reasonably range from plus or minus 1/2 to plus or minus 1 minute under normal operating conditions. As a result, the greatest potential train frequency which can be operated on the rapid rail lines ranges from 2 minutes (90-second design limit plus 30-second variance) to 2 1/2 minutes (90-second design plus 1 minute variance). For the purpose of these capacity estimates, a maximum potential train frequency of 2 minutes has been assumed.

- Equipment: The scheduled frequency is further constrained by the number of cars available for scheduled operation. The maximum frequency as constrained by existing fleet is determined by taking 85% of the active fleet (15% of the fleet is assumed to be held in reserve or being maintained) and dividing by the train constraint will yield the number of trains available. The number of trains is in turn divided into the time required to make one round trip (including the time to turn the train) or the "allowed" time.

Operations. The line capacity is further impacted by the operational variances from headway. That is, if trains are scheduled at three-minute intervals in response to market demand, and if one train operates one minute ahead of schedule, a portion (1/3) of the train's capacity will not be "effectively" utilized. If passengers arrive at station platforms in a uniform temporal distribution, trains arriving at close intervals will not be filled and trains arriving at long intervals will be overloaded.

To reflect the impact of operational variance from scheduled frequency in the capacity estimate, a factor has been included in the calculations to indicate the percentage of train capacity which can be effectively utilized with a variance of plus or minus 1/2 minute from scheduled frequency. The effective capacity factor used in these calculations accounts for the number of passenger spaces which go unfilled because of trains operating ahead of schedule and the number of passengers who are riding in excess of the train loading standard.

The following four pages provide a line-by-line summary of the results of proceeding methodology. This is shown for normal and crush loads under actual, constrained, potential, and design conditions and provides a summary of theoretical operating capacity for the MBTA rapid transit system. The definitions of capacity types used for making assumptions are as follows:

1. Actual Capacity.--Reflects the estimated line capacity given present service schedules.
2. Constrained Capacity.--The number of passengers accommodated with the maximum amount of service which can be provided given the existing vehicle fleet.
3. Potential Capacity.--The number of people that can be carried with an unlimited fleet and station modifications necessary to accommodate such a fleet.
4. Design Capacity.--The maximum capacity possible given the design limitations of the signal system and assuming scheduled 90-second frequencies.

RED LINE "HYBRID" CAR

A) # SEATS/CAR 58

B) STANDEE SPACE 324 sq. ft.

C) STANDEE CAPACITY

Normal load @ 2.5 sq. ft.	129	Crush load @ 1.75 sq. ft.	186

D) TOTAL PASSENGERS/CAR

Normal load	187	Crush load	244

E) TRAIN CAPACITY

@ existing 4 cars		@ potential 6 cars	
Normal load	748	Normal load	1,122
Crush load	976	Crush load	1,464

ACTIVE FLEET 164 PEAK REQ'T 114 (26F + 2 Five)

ALLOWED TRIP TIME 78 minutes

CONSTRAINT (15% of Active Fleet) 140 (35F)

TRAIN FREQUENCY	ACTUAL	POTENTIAL	DESIGN	CONSTRAINT (with current fleet) 4 cars/train	CONSTRAINT (with current fleet) 6 cars/train
headway (minutes)	3.0	2.0	1.5	2.2	3.4
# trains/hour	20	30	40	27	18
effective capacity	.85	.78	.71	.80	.87

	NORMAL LOAD @ 4 Cars	NORMAL LOAD @ 6 Cars	CRUSH LOAD @ 4 Cars	CRUSH LOAD @ 6 Cars
ACTUAL	12,716	19,074	16,592	24,888
POTENTIAL	17,503	26,255	22,838	34,258
DESIGN	21,243	31,865	27,718	41,578
CONSTRAINT	16,157	19,571	21,082	22,926

ABSOLUTE THEORETICAL CAPACITY

NORMAL LOAD @ 4 Cars	NORMAL LOAD @ 6 Cars	CRUSH LOAD @ 4 Cars	CRUSH LOAD @ 6 Cars
29,920	44,880	39,040	58,560

CURRENT ESTIMATED PEAK HOUR VOLUME 15,000 (3/82)

ORANGE LINE

#2 MAIN

A) # SEATS/CAR 58

B) STANDEE SPACE 243 sq. ft.

C) STANDEE CAPACITY

Normal load @ 2.5 sq. ft.	97	Crush load @ 1.75 sq. ft.	139

D) TOTAL PASSENGERS/CAR

Normal load	155	Crush load	197

E) TRAIN CAPACITY

@ existing 4 cars		@ potential 6 cars	
Normal load	620	Normal load	930
Crush load	788	Crush load	1,192

ACTIVE FLEET 120 PEAK REQ'T 68 (17F)

ALLOWED TRIP TIME 77 minutes

CONSTRAINT (15% of Active Fleet) 102(25F)

TRAIN FREQUENCY	ACTUAL	POTENTIAL	DESIGN	CONSTRAINT (with current fleet) 4 cars/train	6 cars/train
headway (minutes)	4.5	2.0	1.5	3.1	4.5
# trains/hour	13	30	40	19	13
effective capacity	.89	.78	.71	.85	.89

	NORMAL LOAD		CRUSH LOAD	
	@ 4 Cars	@ 6 Cars	@ 4 Cars	@ 6 Cars
ACTUAL	7,173	10,760	9,117	13,676
POTENTIAL	14,508	21,762	18,439	27,659
DESIGN	17,608	26,412	22,379	33,569
CONSTRAINT	10,013	12,726	10,760	13,676

ABSOLUTE THEORETICAL CAPACITY

NORMAL LOAD		CRUSH LOAD	
@ 4 Cars	@ 6 Cars	@ 4 Cars	@ 6 Cars
24,800	37,200	31,520	47,280

CURRENT ESTIMATED PEAK HOUR VOLUME 7,000 (3/82)

BLUE LINE

#4 EAST BOSTON

A) # SEATS/CAR 42

B) STANDEE SPACE 170 sq. ft.

C) STANDEE CAPACITY

Normal load @ 2.5 sq. ft.	68	Crush load @ 1.75 sq. ft.	97

D) TOTAL PASSENGERS/CAR

Normal load	110	Crush load	139

E) TRAIN CAPACITY 4 CARS

Normal load	440	Crush load	556

ACTIVE FLEET 70 PEAK REQ'T 40 (10F)

ALLOWED TRIP TIME 45 minutes

CONSTRAINT (15% of Active Fleet) 60 (15F)

TRAIN FREQUENCY	ACTUAL	POTENTIAL	SIGNAL DESIGN	CONSTRAINT (with current fleet)
headway (minutes)	4.5	2.0	1.5	3.5
# trains/hour	13	30	40	20
effective capacity	.80	.78	.71	.85

	NORMAL LOAD	CRUSH LOAD
ACTUAL	5,091	6,432
POTENTIAL	10,296	13,010
DESIGN	12,496	15,790
CONSTRAINT	7,480	9,452

ABSOLUTE THEORETICAL CAPACITY

(@ 4 Cars)

NORMAL LOAD	CRUSH LOAD
17,600	22,239

CURRENT ESTIMATED PEAK HOUR VOLUME 6,000 (3/82)

GREEN LINE "HYBRID" CAR

A) # SEATS/CAR 42 PCC/52 LRV

B) STANDEE SPACE 148 sq. ft. PCC/284 sq. ft. LRV

C) STANDEE CAPACITY

Normal load @ 2.5 sq. ft.	59 PCC/113 LRV	Crush load @ 1.75 sq. ft.	84 PCC/162 LRV

D) TOTAL PASSENGERS CAR

Normal load	101 PCC/165 LRV	Crush load	126 PCC/214 LRV

E) TRAIN CAPACITY

@ existing (Hybrid of 1 LRV/2 PCC)		@ potential (Hybrid of 2 LRV/3 PCC)	
Normal load	174	Normal load	363
Crush load	223	Crush load	449

ACTIVE FLEET 196 PEAK REQ'T 120

ALLOWED TRIP TIME 88

CONSTRAINT (15% of Active Fleet) 167(34T + 99S)

TRAIN FREQUENCY	ACTUAL	POTENTIAL[1]	CONSTRAINT	POTENTIAL[2] HYBRID 3 car PCC / 2 car LRV
headway (seconds)	55	30	40	73
# trains/hour	65	120	90	49
effective capacity	.55	.25	.42	.65

	NORMAL LOAD		CRUSH LOAD	
	Existing	Potential	Existing	Potential
ACTUAL	6,221	12,977	7,972	16,052
POTENTIAL	5,220	10,890	6,690	13,470
CONSTRAINT	6,577	11,562	8,429	14,300

ABSOLUTE THEORETICAL CAPACITY

NORMAL LOAD		CRUSH LOAD	
Existing	Potential	Existing	Potential
20,880	43,560	26,760	53,880

CURRENT ESTIMATED PEAK HOUR VOLUME 7,000

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[1] Potential for currently used cars calculated by creating a "hybrid vehicle" and weighting an average for a 2 car PCC and 1 car LRV.

[2] Potential hybrid car train for future use has a capacity based on weighted average of 3 PCCs and 2 LRVs.

APPENDIX D

Management Rights Act Information (Chapter 581), Executive Performance Evaluation Format

CHAPTER 581

Definition

Chapter 581 of the Acts of 1980 was enacted by the Legislature and signed by the Governor on December 7, 1980. This Chapter is commonly known as the Management Rights Act because it provides MBTA management with the capability to operate the Authority in a manner consistent with normal management prerogatives. These prerogatives, which include most of the major provisions of the Act, include the following:

1. The right to direct, appoint, employ, assign and promote officers, agents and employees.
2. The right to discharge and terminate employees, subject to specific clauses which prohibit such discharge or termination on the basis of race, color, religion, sex, age, national origin, handicapping condition, marital status, political affiliation, or union activities.
3. The right to plan and determine the levels of service provided by the Authority.
4. The right to direct, supervise, control, and evaluate the Authority's departments, units, and programs; as well as the right to classify positions and establish duties and productivity standards.
5. The right to develop and determine levels of staffing and training.
6. The right to determine whether goods or services should be made, leased, contracted for, or purchased on either a temporary or permanent basis.
7. The right to assign and apportion overtime.
8. The right to hire part-time employees.

Other provisions of the Act include, but are not limited to, various items concerning the responsibilities of the Board of Directors, the sale of notes and bonds, and the change in the Authority's budget from a calendar year basis to the State fiscal year as of July 1, 1983.

Due to a union appeal of this legislation, implementation of Chapter 581 did not occur until October 22, 1981 after the Federal Appeals Court affirmed the legality of the Act's provisions.

Management Action

Since implementation began, the MBTA has initiated a number of actions, all of which have had two major objectives: first, to improve service; and second, to reduce expenses, assuming no degradation in the improvement of service efficiency. Examples of these actions include the following.

1. On October 22, 1981, a new policy regarding the allocation of overtime was instituted. This new policy changed the strict seniority-first rule to one which enabled management to select the most capable and available person for the overtime work. The new policy also incorporates a provision which prohibits workers with poor attendance records to be eligible for overtime. During 1981, MBTA management reduced overtime expenditures by $5,803,149, or a reduction in overtime hours of 60%.

2. On October 22, 1981, the Authority stopped the practice of restricting Operators to the assignment of one detail at a time. Operators now can be assigned more than one detail without having to return to their originating point, thus increasing the productivity of those employees.

3. On October 22, 1981, the Authority stopped the practice of allowing senior individuals to obtain overtime on night work trains if it resulted in the inability of that individual to work his regularly scheduled work on the next day (six-hour off work rule). This practice had created overtime expenditures to cover individuals not able to perform regularly scheduled work.

4. On October 26, 1981, the MBTA stopped the practice of not allowing a "blueprint" cover operator from going to another location to cover a vacant run. Old rules prohibited the reassignment of individuals between locations (increased productivity).

5. On October 26, 1981, the Authority abolished a work rule which prohibited a conductor on the second car of a Green Line train from being reassigned as the Operator of a one-car train (increased productivity).

6. On November 17, 1981, the Authority initiated a series of meetings with the Carmen's Union regarding the work practices within the Authority's money room operation. The meeting resulted in a plan agreed upon by union and management. Based on 1982 year end and February 1983 expenditures, the projected annual savings for the money room is expected to be $201,274.58. This savings has been accomplished by a combination of increased productivity and new equipment (revised 3/18/83).

7. On November 28, 1981, the Authority reassigned car cleaners and shifters on the Green Line to locations and work shifts where management determined a need existed. This was accomplished without observing former restrictions requiring bidding for locations and shift times (increased productivity).

8. On November 28, 1981, management established a policy that, if a car cleaner on the Green Line was qualified to perform shifter's work, he would do so if the need existed. Conversely, if a shifter was not shifting and cleaning work was needed, shifters would be required to clean vehicles (increased productivity).

9. On November 28, 1981, the Authority reclassified stock clerks as roving stock clerks. They now may cover more than one location. This action has resulted in increased productivity and a cost avoidance of hiring stock clerks for each location ($30,000 to $60,000 in savings).

10. On November 28, 1981, the Authority reassigned 22 of the 44 individuals who were assigned only to track walking to preventive maintenance and other duties. The remaining 22 track walkers were assigned to cover track based on needs dictated by track reliability data (increased productivity).

11. Starting in November 1981, and on a continuous basis thereafter, the Authority developed specifications for the cleaning of stations, buildings and vehicle interiors. As a result of this work, the Authority has implemented the following contracts.

Contract Area	Amount (Annual Basis)	Contract Start Date	Annual Savings
1. Janitorial Services - All "T" facilities	$674,474.00	6/21/82	$395,530.00
2. Interior Cleaning of Buses - Charlestown, Fellsway and Lynn Garages	276,768.60	6/5/82	157,231.40
3. Interior Cleaning of Buses - Albany, Cabot, Bartlett and Quincy Garages	394,187.60	10/22/82	328,356.60
4. Blue Line Station Cleaning	243,900.00	6/21/82	140,008.00
5. Downtown Station Cleaning - Washington St., Park St., Government Center (Green only) and State St. (Orange only)	309,966.00	11/23/82	204,261.90
6. Green Line (North) Station Cleaning - Haymarket, N. Station, Science Park and Lechmere	117,000.00	12/15/82	52,154.19
7. Red Line Station Cleaning Contract - Charles/MGH, Kendall, Central, Harvard/Holyoke and Harvard/Brattle	103,272.00	12/15/82	129,357.82
8. Green Line Station Cleaning - Boylston, Arlington, Copley, Auditorium, Kenmore Prudential and Symphony	167,328.00	12/15/82	216,973.15

Contract Area	Amount (Annual Basis)	Contract Start Date	Annual Savings
9. Orange Line Station Cleaning - Community College, Sullivan Sq., Wellington, Malden Center & Oak Grove	$90,000.00	12/15/82	$191,243.09
10. Interior Cleaning of Red Line Vehicles	98,354.00	Est. 4/2/83	338,070.95
TOTAL	$2,475,280.20		$2,153,187.10

(Revised 3/18/83)

12. On November 28, 1981, the Authority changed the method of rubbish collection to enable carhouse and garage personnel to dispose of rubbish into dumpsters rather than sending special groups of workers out to pick up trash (increased productivity).

13. On November 28, 1981, the Authority stopped the practice of sending two welders and two grinders on work assignments. Now one welder and one grinder will be assigned to accomplish the same work previously done by four employees (increased productivity).

14. On November 28, 1981, the Authority abolished two tool room attendant positions and reassigned the individuals as car cleaners. This avoided approximately $60,000 in labor costs which would have occurred if the vacant car cleaner positions were filled with outside personnel.

15. On December 1, 1981, the Authority reassigned 36 repairmen on the Green Line to locations and shifts as determined by management. This was accomplished without a re-pick (increased productivity).

16. On December 1, 1981, the Authority resassigned 27 individuals working on LRV modifications to new shift hours without re-picking (increased productivity).

17. The MBTA eliminated the system-wide selection of work by surface operators which was scheduled for 1981. This action will save approximately $85,000 in training and retraining costs.

18. The MBTA curtailed the posting and bidding of vacancies which in the past has created extensive movement of the work force among the various locations of the Authority. This action will result in a savings of approximately $150,000 associated with training, retraining and administration time.

19. During November, December and January, the Authority held meetings with the Carmen's Union regarding the employment of part-time bus operators. The Union strongly objected to implementation of part-time operators, but the Authority integrated 20 part-time employees into the winter schedule in Quincy. Since then, the employment of part-time operators has continued at a more rapid pace than originally anticipated. Eighty part-time operators were added to the summer, 1982 schedule. An additional 120 part-time operators are being hired for the fall, 1982 schedule, and 200 more will be added during

1983/FY84. Annualized savings from the hiring of part-time workers may exceed $6 million.

20. The Machinists' Union was advised in two meetings during January and February, 1982, that it is the intention of the Authority to implement part-time fuelers in the automotive area and to combine machinists' classifications in the Everett Shops. The use of a third classification of mechanics to take over fueling tasks, allowing 39 1st and 2nd class mechanics now performing these duties to be reassigned to bus maintenance and repair is now anticipated to start by the fall of 1982. This reassignment will be phased in at all garages over a period of several months. Annual savings to the Authority will be approximately $685,000 based on the lower rate of pay for this third classification. Additionally, increased productivity by reassigning trained mechanics from their fueling duties to bus maintenance is expected.

21. Also accomplished in 1981, either directly by the passage of Chapter 581 or by assistance it afforded, were:

    a. Reduction in the number of "T" employees in 1981 by 609. The annualized savings of this decrease is approximately $21 million.

    b. The contribution required on overtime earnings to the pension fund was abolished. The annualized savings to the Authority based on 1981 overtime would be approximately $515,000.

    c. Abolition of automatic cost-of-living salary adjustments. Savings over the last year is $15 to $20 million.

22. The Authority integrated thirteen part-time gatemen into the summer 1982 schedule. Annualized savings from this action are expected to be approximately $165,000.

23. The Authority placed a system-wide restriction on the internal bidding procedures. All employees must now stay a minimum of two years in a job before they are eligible to bid for a new position. This should increase productivity and reduce the costs normally associated with the constant movement of employees (such as training and administrative costs).

24. Engineering and Maintenance electrical workers have been reassigned and will only be allowed to bid for jobs for which the Authority determines they are qualified. This will increase productivity and decrease training costs.

25. The Authority eliminated the practice of requiring yard motormen to drive tampers out of the yard. Operators now perform this function, eliminating the overtime that was usually paid to yard motormen for this duty.

26. The Authority has changed the normal work week for trackmen to include weekends. This decreases overtime paid for weekend work. It also increases productivity and reduces service interruptions by allowing the Authority to increase the amount of track work done on weekends when fewer vehicles are operating.

27. The practice of having to assign five roofers every time a "kettle" is used has been eliminated, resulting in increased productivity.

28. The Authority is now purchasing, from private companies, fabricated ductwork as necessary. Previously all such work had to be done in the Authority's own shops.

29. Warranty repair work on buses, which in the past had been performed by Authority personnel, was recently done by representatives of the bus company (Canadian Flyer). This led to an increase in productivity (Authority bus mechanics could continue with their regular duties). This action should also improve the strength of any future claims made under the warranty agreement.

30. The Authority established a new classification and rate of pay for information specialists. By establishing a new classification for this work, the Authority avoided higher costs for the work. The information specialist should improve the Authority's ability to deliver information to the public.

31. The Authority has eliminated the practice of automatically assigning switch cleaners to work in pairs over the winter. Whether or not cleaners are assigned in pairs will be determined by management. This will result in an increase in productivity.

32. Engineering and Maintenance crew sizes, which were previously determined by collective bargaining agreement, are now being evaluated and assigned at management's discretion (4-man power line crew, 3-man emergency crew).

33. On May 27, 1982 the Authority signed a one year contract with a private security firm to provide watchmen services at 3 Authority locations. The contract is for $163,501 and is expected to save the Authority $234,083 on an annual basis.

34. On March 10, 1983 the Board of Directors approved a $6 million contract award for Blue Line Track Improvements. Previous to C.581 this type of work could not have been awarded to an outside firm.

35. Engineering and Maintenance truck drivers will replace motormen on high speed rail vehicles. This will result in an estimated annual savings of $37,616.

36. Engineering and Maintenance trackmen will begin doing their own rail burning, replacing ironworkers who previously did this work. This change of assignment will result in the saving of the equivalent of $87,051 of ironworkers' time to perform other needed duties.

37. The Authority is currently preparing to implement changes in the job responsibilities and the method of assignment of Engineering and Maintenance truck drivers. These changes, which include broadening the truck drivers' responsibilities to include first level maintenance, are estimated to save the Authority $175,909 on an annual basis.

38. Continuing the process begun in November 1981 (see item #11), the contract for the Interior cleaning of Buses at the Charlestown, Fellsway and Lynn Garages was rebid after one year, upon its expiration. The contract was awarded to the low bidder at an annual cost of $282,530.40. This contract,

for the period June 7, 1983 to June 6, 1984 is estimated to save the Authority between $312,219.17 and $396,751.28 on an annual basis.

39. The Authority continued the practice of having an outside security firm provide watchmen services by rebidding this contract after the original one year contract expired (see item #33). The contract, which is for the period May 29, 1983 to May 28, 1984, is for $162,762.96 and is estimated to save the Authority between $270,761.84 and $309,243.93.

CONFIDENTIAL

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

EXECUTIVE PERFORMANCE APPRAISAL

Name of Person Rated ______________________________

Position Title ______________________ Grade __________

Department ______________________________

Years of Service __________ Years in this Position __________

DIRECTIONS: The purpose of this appraisal is to aid in the development of each individual by affording a means of documenting good performance or identifying areas of performance in which improvement is needed. The form should be completed by the immediate manager or supervisor whose position is evaluated in Grade I through IV, reviewed with the next higher level of supervision for concurrence or guidance, up through the Directorate Head level, then discussed with the person being rated.

RATING SCALE

5.....DISTINGUISHED - Performance that is consistently of exceptional quality. Assigned tasks are completed with superior results in all areas. Contributions towards the goals of the Authority are unique, beneficial and noticeably outstanding. A top achiever or administrator.

(Approximately 10 percent of the Executives would meet this standard.)

4.....ACCOMPLISHED - Performance is consistently above expectation. Achievement on major assigned tasks and overall contribution are above expectation.

(Approximately 30 percent of the Executives would meet this standard.)

3.....COMPETENT - Performance reflecting a level of results which meets normal or average expectations. Overall contribution is of high quality.

(Approximately 45 percent of the Executives would meet this standard.)

2.....FAIR - Performance generally meets the standard normally expected, but is inconsistent. Improvement is needed in one or more areas to consistently satisfy job requirements. An individual receiving an overall rating at this level will be involved in further action as outlined in PART II of this form.

(Approximately 10 percent of the Executives would fall within this standard.)

1.....UNSATISFACTORY - Performance is unacceptable. Individual has had ample opportunity to be knowledgeable about assigned tasks, but has not met the minimum expectations. An individual receiving an overall rating at this level will be involved in further action as outlined in PART II of this form.

(Approximately 5 percent of the Executives would fall within this standard.)

INSTRUCTIONS

Please use the scale on the following page to rate the individual's performance in each category. Read the criterion and select a numerical rating from 1 to 5 which most represents the employee's performance and supply specific comments, if appropriate. For detailed instructions, see Page 7 of this form.

PART I.

PERFORMANCE FACTORS

		RATING
KNOWLEDGE OF ASSIGNED TASKS	Consider the degree of understanding of obligations pertinent to the position...the demonstration of proficiency as a result of knowing the job requirements.	
QUALITY OF WORK	Consider the thoroughness, accuracy and effectiveness of work. How skillfully performed?	
PRODUCTIVITY	Consider demonstrated accomplishments and volume of work output. Does the person do what is expected and perhaps more?	
JUDGMENT	Consider ability to plan work and make logical and practical decisions.	
HUMAN RELATIONS	Consider the ability and willingness to develop good working relationships with associates, supervisors and others in the execution of assignments. Has the person abided by his or her responsibilities under the Authority's EEO/AA obligations?	
RESPONSIBILITY	Consider the level of responsibility of the position. Does the person accept the responsibilities by concentrating on assigned tasks, utilizing time, planning the work and allocating resources?	
DEPENDABILITY	Consider the person's reliability with respect to attendance and work completion. Conscientiousness is most important.	
OVERALL PERFORMANCE RATING	Consider all of the above factors and select an overall performance rating.	

PART II. FAIR OR UNSATISFACTORY PERFORMANCE

(Complete for any employee who receives an overall rating of fair or unsatisfactory and who needs to improve in one or more areas.)

Indicate next planned action:

________________ Further training

________________ Counseling

________________ Re-assignment

________________ Possible termination

________________ Other (please explain) ____________________

____

____

PART III. ACCOMPLISHMENTS FOR THIS RATING PERIOD

Projects, assignments or plans agreed to in last appraisal	Target Date	Date Done	How well done? If not completed, why not? Rescheduled for when?

PART IV.

OBJECTIVES FOR NEXT RATING PERIOD

Projects, Assignments or Plans	Priority	Target Dates

EMPLOYEE COMMENTS: (Optional)

SIGNATURES:

Rater ______________________ Date ____________

Reviewed by ______________________

Employee ______________________

Department Head ______________________

Noted by Personnel ______________________

Noted by General Manager ______________________

SUPERVISORY COMMENTS: (Optional)

INSTRUCTIONS

This form shall be processed as follows:

A. Refer to the appraisal completed during the last review of the employee involved. Copies of appraisals shall be maintained by supervisors under confidential conditions. Assistance in obtaining previous appraisals that cannot be located is available from Personnel.

B. Review the employee's job description and determine from the last appraisal the standards of performance expected and the results that were achieved.

C. On the front of the form, fill in the identifying data pertaining to the person being rated.

D. Turn to Page 2 and review the criterion for each rating on the scale.

E. Proceed to appraise the employee on each of the Performance Factors set forth in PART I by placing a numerical rating after each factor in the space provided. Specific comments should be provided where necessary to clarify the performance factor rating. These comments should be related to work standards set from the job description and the goals and objectives set forth in PART III.

F. In the next section, select a rating which is your assessment of the employee's performance over the rating period and the contributions made by the employee to the department and organization.

G. If based on the prior section the employee receives a "Fair" or "Unsatisfactory" rating, PART II must be completed.

H. In PART III, the objectives decided upon at the last appraisal shall be listed and assessed as to the degree of success in bringing them to a final conclusion.

I. PART IV will not be filled out until after the appraisal interview, since the employee will have input at that time. However, tentative goals for this employee, as you envision them, should be set forth in the Annual Performance Planning Worksheet, which should be attached. Then, sign the form in the space for the Rater on Page 6 of the PER-3(E).

J. Next, complete an Executive Employee Salary Review Report, PER-3(SRR), following the directions contained thereon. It then will be attached to the PER-3(E) Performance Appraisal and sent together through channels to the department head.

K. Both forms will be reviewed at the department head level for compliance with organizational objectives and for consistency with budgetary responsibilities. The forms then will be separated, and the PER-3(E) returned to the Rater, while the PER-3(SRR) shall be held at the department head level.

INSTRUCTIONS (Cont'd.)

L. Upon return of the PER-3(E) from the department head, the person rated shall be notified in writing, at least one day in advance, of the time and place of the interview. Also, accompanying the notification should be a copy of the employee's job description and a blank copy of an Annual Performance Planning Worksheet. The employee should be instructed to complete this form relative to his or her goals for the upcoming appraisal year and be prepared to discuss them at the performance interview, since this document will be the basis for the mutual establishment of the goals which will become criteria for measurement in PART IV of the PER-3(E) for the next year.

M. Conduct the appraisal interview, which is perhaps the most important segment of the appraisal process. Specific guidelines for such interviews are set forth in Staff Procedure No. 13A. The supervisor and the employee should mutually establish the goals and objectives for the next appraisal year by comparing the goals listed on the Annual Performance Planning Worksheets before reviewing the employee's performance for the current appraisal year.

N. After completion of the interview, the employee should sign the form, indicating his/her awareness of the content. If a dispute exists relative to any portion of the evaluation, the employee should be afforded the opportunity to comment in the section provided on Page 6.

O. The PER-3(E) shall be forwarded through channels to the General Manager's level, with the PER-3(SRR) being attached at the appropriate level in the process.

P. Upon the General Manager's notation on the forms, the PER-3(E) shall be sent to the Personnel Department for inclusion in the employee's personnel file. Form PER-3(SRR) shall be forwarded to the Personnel Department for notation, and then to the Treasurer-Controller's Department for implementation of the salary adjustment.

(Space for further comments, if necessary):

ANNUAL PERFORMANCE PLANNING WORKSHEET

Objectives must be achievable, realistic, measurable and time-bounded.

PRIORITY	OBJECTIVES (What must be accomplished?)	MEASUREMENT (Quantity, quality, cost or other)	TIME FRAME (Target date for completion)	PLAN FOR ACHIEVING THE OBJECTIVE (What must be done to accomplish objective?)

Signature ______________________ Date ____________

EXECUTIVE EMPLOYEE SALARY REVIEW REPORT

Name of Person Rated __________

Department __________

Position Title __________

Grade __________ Present Salary __________

DIRECTIONS: The purpose of this report is to provide suggested guidelines for a salary adjustment based on performance appraisal. It takes into account budgetary constraints and requires comparison of job performance of the person rated to other employees in the same department. Therefore, before you complete this form for any one individual, you should make an overall assessment and comparison of all the individuals you rate, if you evaluate more than one person. Refer to the PER-3(E), which will be attached to this form, and, in particular, to the OVERALL PERFORMANCE RATING on Page 3, and the suggested range of increases for 1983 ratings, set forth below. Write in the spaces provided the individual's 1983 Overall Performance Rating, the Recommended Percentage Increase and the Dollar Amount.

OVERALL PERFORMANCE RATING	SUGGESTED RANGE OF PERCENTAGE INCREASE
DISTINGUISHED	9 to 11
ACCOMPLISHED	7 to 9
COMPETENT	5 to 7
FAIR	1 to 4
UNSATISFACTORY	0

1983 OVERALL PERFORMANCE RATING __________ RECOMMENDED PERCENTAGE INCREASE __________ DOLLAR AMOUNT __________

SIGNATURES:

Rater __________ Date __________

Reviewed by __________

Department Head __________

Noted by Personnel __________

Noted by General Manager __________

PER-3(SRR)

APPENDIX E

Estimate of Ridership Losses

APPENDIX E - ESTIMATES OF RIDERSHIP LOSSES

Summary

An analysis of November 1980 and 1981 ridership levels on the MBTA has revealed that a reduction in linked trips of 15.0 percent has occurred from 1980 to 1981. This represents approximately 90,200 fewer trips per average weekday. Of these trips, CTPS estimates that 32,000 trips were lost due to service cuts. Further, the MBTA estimates that 1,500 trips were lost due to the bus replacement program on the Mattapan High Speed Trolley Line. These two adjustments bring the loss in trips on the MBTA due solely to the fare increase of August 1981 to 56,700 trips per average weekday or a 9.4 percent reduction in total ridership.

This analysis used an average fare of 69.7 cents per trip in November 1981, which was derived from the results of a ridership sample taken during November. The November 1980 average fare was estimated at 43.5 cents.

Introduction

This memorandum describes the results of an analysis to determine ridership levels on the MBTA's rapid transit and bus lines during November 1981. This ridership level is compared with the level estimated for November 1980 to determine the magnitude of the loss in ridership due to the fare increase implemented in August and the service reduction made during the first six months of 1981.

The analysis was conducted by the Central Transportation Planning Staff (CTPS) at the request of the Massachusetts Bay Transportation Authority (MBTA) as part of the work being done for the preparation of the Environmental Impact Report (EIR) and Socioeconomic Impact Report (SEIR) on the MBTA Fare Increase. As part of the agreement which permitted the MBTA to increase fares prior to the completion of an EIR, the MBTA must determine the change in ridership for November 1981. CTPS's work was conducted to estimate the magnitude of the loss in ridership during November.

The basic sources of data and the methods used to estimate ridership on rapid transit and bus lines during November 1981 are briefly described in the next section. The results are then presented and are compared with ridership levels for November 1980. A detailed discussion of the assumptions and process is in the technical appendix.

Method of Analysis

The MBTA does not count total riders on a daily or monthly basis. Ridership levels, therefore, must be estimated using revenue (which is counted daily by the MBTA) and an estimate of the average fare paid by each rider. The average fare is based upon several factors: the mode used (rapid transit, local bus, zoned bus or express bus); the type of rider (full cash fare adult, elderly or handicapped, student or child); the method of fare payment (whether cash or prepaid pass); and the time of travel for elderly or handicapped riders. Since the ridership levels are dependent upon the average fare, and the average fare is dependent upon several variable factors, a program was instituted to determine the average fare being paid on the MBTA.

The MBTA, in conjunction with CTPS, developed a program to collect information on the components of average fare for bus, surface streetcar, and rapid transit lines. Due to time and money constraints, a sampling technique was used. CTPS selected a random sample of bus and Green Line driver runs and a sample of rapid transit stations. The samples were significant at the 0.05 level with a ± 2.5 percent confidence interval. The MBTA's staff of checkers collected the data during November. CTPS edited, coded, and analyzed the data.

For each bus or surface Green Line run sampled, the MBTA recorded the number of riders boarding and the type of fare paid--adult full cash or prepaid pass; elderly or handicapped (free or half fare); student (pass or half fare); or other free-authorized or unauthorized. The fare box revenue was also recorded, enabling the calculation of an average fare. The average fare was applied to total surface revenue to determine the number of riders on surface vehicles.

The number of rapid transit trips was derived using the MBTA's turnstile counts, an estimate of pass use, and the non-token revenue received at each station. The cash gate revenue was translated into riders by using an average fare derived from the sampling program. The sampling program provided information on the number of persons passing through the collector's booth turnstile or through the non-turnstile gates at rapid transit stations; the type of fare paid (full cash, prepaid pass or reduced fare); and the fare box revenue. Prepaid pass use was estimated from the turnstile passmeter readings and the sampling program.

These methods and the results of the analysis are explained more fully in the technical appendix to this memo.

November Ridership Levels

The number of unlinked surface and rapid transit trips in November 1981 are provided in Table 1. The ridership profiles, average fares and uses/pass for unlinked trips are also provided. An unlinked surface trip is defined as a trip made using only one surface vehicle. An unlinked rapid transit trip is defined as a trip made on the rapid transit system, including the underground portion of the Green Line and can include transfers from one transit line to another. These figures are compared with the number of unlinked trips for November 1980 as follows:

	Nov.'81	Nov.'80	% Change
Unlinked rapid transit trips/average weekday	310,100*	360,300	-13.9%
Unlinked surface trips/average weekday	422,100	507,000	-16.7%
TOTAL	732,200	867,300	-15.6%

*Includes 4,400 previously uncounted DRTX trips.

The total loss in unlinked trips is approximately 16 percent.

An estimate of the number of linked trips was made using the ratio of rapid transit only, surface only, and transfer trips from the 1978 Wilbur Smith Systemwide Survey as a base and adjusting it for service cuts and fare increases instituted since then. The results are shown as follows:

TABLE E-1

DISTRIBUTION OF UNLINKED TRIPS BY FARE PAYMENT
(November 1981)

	Unlinked Rapid Transit Only	Unlinked Surface Only
Adult - cash	48.5%	39.6%
- prepaid pass	29.2%	30.7%
E & H - half fare	3.8%	5.3%
- free	11.1%	6.3%
Students	5.8%	12.2%
Other free - authorized*	1.2%	5.4%
- unauthorized	0.4%	0.5%
Total trips/average weekday	310,100	422,100
Uses/prepaid pass/month	44**	57**
Average fare	60.0 cents	39.6 cents

Source: Survey of November 1981 Ridership.

*Includes free trips in outbound direction surface Green Line.

**The uses per prepaid pass per month is not measured directly but rather has been derived from information on daily pass usage gathered from a sample of bus routes and rapid transit stations. Due to the estimation procedure, the values presented have a lower level of reliability than the other numbers presented, and care should be taken if used outside the context of this analysis.

Mode	Number of Trips/ Average Weekday (Nov. 1981)	Proportion	Average Fare
Rapid transit only	137,997	27%	60.0 cents
Combined rapid transit and surface trips	194,218	38%	98.9 cents
Surface only	178,885	35%	45.5 cents
TOTAL system	511,100	100%	69.7 cents

An estimate of the number of linked trips/average weekday in November 1980 shows that a loss of approximately 90,200 trips or 15.0 percent of the trips occurred, as follows:

Mode	Number of Trips/ Average Weekday (Nov. 1980)	Percent Change (1980-1981)
Rapid transit only	156,300	-11.7%
Combined rapid transit and surface trips	234,500	-17.2%
Surface only	210,500	-15.0%
TOTAL system	601,300	-15.0%

The ridership profiles are shown in Table 2. The greatest loss in trips was seen in the number of adults paying full cash fares. The largest increases were in the number of elderly riders and in the number of prepaid pass users. The distribution of riders by type of mode are presented in the appendix*; however, these distributions are made with less certainty and, therefore, care should be taken when using figures concerning the subcategories of users.

---

* Source: C.T.P.S. Tech. Report #39

Appendix E

TABLE E-2

DISTRIBUTION OF RIDERS BY FARE MIX AVERAGE WEEKDAY (IN 000's)

	November 1981 # of Riders (%)	November 1980 # of Riders (%)	% Change
Adult - cash	209.6 (41.0%)	321.1 (53.4%)	-34.7%
- prepaid pass	174.8 (34.2%)	151.5 (25.2%)	+15.4%
E & H - half fare	22.0 (4.3%)	46.3 (7.7%)	+35.8%
- free	40.8 (8.0%)		
Students	45.0 (8.8%)	59.5 (9.9%)	-24.4%
Other free - authorized	16.9 (3.3%)	22.9 (3.8%)	-17.4%
- unauthorized	2.0 (0.4%)		
TOTAL	511.1 (100%)	601.3(100.0%)	-15.0%
Average fare	69.7 cents/trip	43.5 cents/trip	

Source: C.T.P.S.

In an attempt to determine the cause of the reduction in ridership, two major changes on the MBTA are cited: 1) the fare increase implemented in August 1981, and 2) the service reductions initiated in April 1981. In addition, it has been estimated that the bus replacement program on the Mattapan High Speed Trolley Line has caused a drop in ridership. Of the 90,200 fewer trips made on an average weekday than in 1980, CTPS estimates that 32,000 were lost due to service cuts (5.3 percent). The MBTA estimates that 4,500 (0.2 percent) of the lost trips were due to the bus replacement program. This, therefore, implies that the loss due to the fare increase was approximately 56,700 trips per average weekday (9.4 percent loss from November 1980).

Ridership figures have been adjusted since the publication of the Draft Environmental Impact Report, published in April 1982, to reflect better estimates of the ridership loss due to the DRTX Project. The following memo (Part II) shows the revised estimate of ridership loss due to the DRTX project. The revised estimate is 1,500 trips lost (down from 5000). Nine hundred additional trips were not counted for a total of 4,400 one-way trips.

MASSACHUSETTS
BAY
TRANSPORTATION
AUTHORITY

To: Files

From: Alan H. Castaline

Date: June 9, 1982

Re: Ridership Loss Attributed to the DRTX Project
(Revised 7/1/82)

The DRTX Project was a track and tunnel reconstruction program for the Mattapan High Speed Line and the Dorchester Branch of the Red Line. During the approximate seven month duration of the DRTX Program, from June 1981 to January 1982, a bus replacement service was provided. The replacement service was designed to carry about 70-80 percent of the Dorchester RTL commuters. The March 9, 1982 Draft Report prepared by CTPS entitled "MBTA Fare Study - Estimate of November Ridership" uses a previous crude estimate of 5,000 trips lost due to the DRTX Project.

The following presents an analysis to refine the previous estimate for the number of trips lost due to the DRTX Project. For the purposes of this analysis, the DRTX ridership loss is divided into two categories: (I) Passenger trips not counted by the November 1981 Fare Survey, and (2) Passenger trips not made.

I. Passenger Trips Not Counted - Given the approach selected for the November Fare Survey and the methods used for estimating ridership, local travel between Dorchester Branch RTL Stations (between Ashmont and Andrew) were not recorded. Local trips were not observed by the survey because these passengers neither entered through a RTL turnstile or contributed revenue to the surface receipts.

As shown in Table 1, historically there have been about 2,200 local round trips made daily between Dorchester stations on the Red Line. However, it is acknowledged that the approach used to derive this estimate does not account for a number of factors including:

o Ridership growth since 1978.

o Loss in ridership due to service cuts, the 1980 RTL fare increase and the 1981 bus fare increase.

o The influence of linking with RTL feeder bus service.

o New local ridership due to high frequency of service offered by replacement bus along Dorchester Avenue.

In total, the above is assumed to have no impact on the ridership estimate for local travel, and therefore, it is estimated that 2,200 RTL round trips were not recorded by the November 1981 Survey.

II. Passenger Trips Not Made - The CTPS draft report of March 9, 1982, assumed that 5,000 one-way trips were lost due to the DRTX Project. Table 2 presents a comparison of the boardings on the Dorchester Branch before (November 1980) and during (November 1981) the DRTX Project. It is now conservatively estimated that 750 daily round trips were not made due to the inconvenience experienced by the Dorchester Red Line passengers. This is in addition to the estimated 2,200 round trips not observed by the November 1981 Survey.

III. Summary - Two adjustments to the conclusions presented by the CTPS memo of March 9, 1982, "MBTA Fare Study - Estimate of November Ridership," are required as shown in the following table:

	Existing Estimate		Revised	
Total Ridership Loss	94,600	(15.7%)	90,200	(15.0%)
Service	32,000	(5.3%)	32,000	(5.3%)
DRTX	5,000	(0.8%)	1,500	(0.2%)
Fare	57,600	(9.6%)	56,700	(9.4%)
Total 1981 Ridership	506,700		511,100	
Total 1980 Ridership	601,300		601,300	

The revised estimates reflect revisions associated with the refinement to the DRTX ridership and do not necessarily preclude the need for other adjustments in the calculations for the estimated daily ridership volumes for either 1980 and 1981.

Alan H Castaline

Alan H. Castaline
Acting Chief Service Planning Officer

AHC/wmh
Attachment

Table 1

DRTX Ridership Analysis

"Passenger Trips Not Counted"

	Boardings		
	Inbound	Outbound*	Total
Andrew	3,476	806	4,282
Columbia	3,215	856	4,071
Savin Hill	1,365	249	1,614
Fields Corner	4,011	434	4,445
Shawmut	1,110	26	1,136
Ashmont	9,359	0	9,359
	22,536	2,371	24,907
Inbound Alighting*	2,608**	2,608	
Downtown Travel	19,928		
Local trips (one way)		4,979	
Est. South Shore O/D's		590	
Est. DRTX Local trips		4,389	

*Outbound Boardings and Inbound Alightings represent local travel. It is assumed that 33 percent of the local trips through Andrew Station originate or are destined for the South Shore. Given the methods of sampling and estimating ridership used, the local DRTX trips were not reflected in the November 81 Fare Survey.

**See Table 1-A

Source: Tabulation of Station Boardings and Alightings from 1978 RTL Comprehensive Survey performed by Wilbur Smith and Associates and prepared by CTPS for the MBTA.

Table 1-A

DRTX Ridership Analysis

"Passenger Trips Not Counted"

Alightings

	Inbound	Outbound	Total
Andrew	964	3,661	4,625
Columbia	837	3,394	4,231
Savin Hill	272	1,426	1,698
Fields Corner	470	4,144	4,614
Shawmut	65	1,204	1,269
Ashmont	0	9,614	9,614
Totals	2,608	22,443	26,051

Source: Same as Table 1

Table 2

DRTX Ridership Analysis

"Passenger Trips Not Made"

	Nov 1980*	Nov 1981*
Ashmont	10,220	
Shawmut	1,687	
Fields Corner	5,244	
Savin Hill	1,942	
Columbia	4,538	2,667
Andrew	4,312	13,449
Subtotal	27,943	16,116
No. Quincy	4,754	9,181
Total	32,697	25,297
Local Trips		4,389
		29,686

November 1980	32,697	
November 1981	29,686	
Total Loss "DRTX" (unadjusted)	3,011	
	600	Less B.A.T. Passengers to Braintree**
	2,411	
	1,260	Less loss due to Fare Increase***
	1,151	
	384	Less estimated transfer to other services (assumed 33%)
Total Loss "DRTX"	767	Passenger round trips not made due to DRTX Project.

*Source: MBTA RTL 210 reports and "MBTA Fare Study" by CTPS, 3/9/82.

**Source: Brockton Area Transit

***Assumed fare elasticity of .15, with a weighted average fare increase experienced by the DRTX riders on August 1, 1982, of approximately 30 percent.

APPENDIX F

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Appendix F-1

Air Quality Standards and Current Attainment Levels

1. Ozone

The primary standard (to protect health) is 0.12 ppm for a one-hour period.

To be in attainment, the average number of days per year greater than this value must be less than or equal to 1 when averaged over 3 years.

The secondary standard (to protect vegetation & materials) = 0.12 ppm.

2. Carbon Monoxide

The primary standard = 9 ppm averaged over an 8-hour period
= 35 ppm averaged over a 1-hour period

To be in attainment, these levels are not to be exceeded more than once/year.

The secondary standard = same as primary.

AIR QUALITY STANDARDS AND ATTAINMENT

MUNICIPALITY	# of OBS.	1980 MAX	2nd MAX	# of OBS.	1980 MAX	2nd MAX
BOSTON	682	.070	.068	7711	.115	107
BOSTON	4565*	.120	.110			
MEDFORD	1385**	.079	.073			
SOMERVILLE	3074	.140	.132			
WATERTOWN	3315	.145	.134			

NOTES: *When total observations are less than 2,000, the sample cannot be guaranteed to contain the actual maximum concentration value for the ozone season. An observation is a single hourly reading at a site; 100% data capture during the 4/1 to 10/31 ozone season represents 5,136 observations at each monitor.

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*Monitor in operation 7/1 to 7/31
**Monitor in operation 4/1 to 5/31

SOURCE: DEQE

AMBIENT OZONE DATA SUMMARY (1980-1981)

TABLE F-1

MUNICIPALITY	# of OBS	1980 MAX 1 HR (mg/M^3)	2nd MAX 1 HR	MAX 8 HR	2nd MAX 8 HR	# of OBS	1980 MAX 1 HR (mg/M^3	2nd MAX 1 HR	MAX 8 HR	2nd MAX 8 HR
BOSTON	5594	16	14	12	11	6571	22	16	14	10
BOSTON	2878*[a]	18	16	12	12					
BOSTON	1834*[b]	9	8	5	5	7344	12	12	10	8
BOSTON	2200*[c]	29	22	14	11	6512	22	22	14	12
MEDFORD	3497*[d]	20	19	12	12					
SOMERVILLE						7207	17	15	10	8
WATERTOWN	6167	10	10	8	7					

NOTE: *When total observations are less than 4,000, the sample cannot be guaranteed to include the actual maximum concentration value for the year. An observation is a single hourly reading at a site.
Carbon monoxide data are collected throughout the year; 100% data capture during that period represents 8,760 hourly observations.

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[a] Monitor in operation 1/1 to 6/30
[b] Monitor in operation 7/1 to 12/31
[c] Monitor in operation 10/1 to 12/31
[d] Monitor in operation 1/1 to 6/30

SOURCE: DEQE

AMBIENT CARBON MONOXIDE DATA SUMMARY (1980-1981)

TABLE F-2

UNITS: UG/M^3

MUNICIPALITY	ARITH. MEAN	# of OBS.	1980 MAX. 1 HR.	ARITH. MEAN	# of OBS	1981 MAX. 1 HR.	ARITH. MEAN
BOSTON	50	5186	338	93	6543	200	40
BOSTON	57	2333*[a]	395	101			
BOSTON		2029*[b]	197	61	7323	114	30
SOMERVILLE		346*[c]	132	45	5449	126	30
WATERTOWN		2182*[d]	417	37			

NOTE: *When total observations are less than 4,000, sample size is insufficient to represent sound data results. An observation is the number of hourly readings taken at a site.

NMOC and NOx emission densities - MAPC Region, 1980. (in $kg/hr/km^2$)

NMOC	NOx
4.415	4.761

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[a] Monitor in operation 1/1 to 4/30.
[b] Monitor in operation 7/1 to 12/31.
[c] Monitor in operation 10/1 to 12/31.
[d] Monitor in operation 6/1 to 9/30.

SOURCE: DEQE

AMBIENT NITROGEN DIOXIDE DATA SUMMARY (1980-1981)

TABLE F-3

	Point Source	Area Source	Mobile Source	Total
NMOC (kg/day)				
- 1980	56,553	127,549	157,080	341,182
- 1987*	29,879	117,596	62,396	214,392
	-47%	-8%	-60%	-37%
NOx (kg/day)				
- 1980	123,981	86,079	202,285	412,255
- 1987*	114,171	93,420	168,635	376,226
	-8%	+9%	-17%	-9%

- Mobile source inventory: based on seasonally adjusted DVMT, and on emission factors (from Mobile-2)

- Bulk of projected highway vehicle emission reductions: due to FMVECP and the Mass. I&M Program which goes into effect on April 1, 1983.

	Point Source	Area Source	Mobile Source	Total
CO (kg/day)				
- 1980	15,598	40,494	1,643,433	1,699,525
- 1987	15,228	40,415	844,377	940,021
	-2%	-0.2%	-46%	-45%

- For mobile sources, emissions of CO were calculated in the same way as for NMOC & NOx. However, CO assumes winter conditions.

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*Shows impacts of existing DEQE Regulations, FMVECP and the Mass. I&M Plan.

CURRENT AND ATTAINMENT LEVELS
FOR SELECTED INDICATOR POLLUTANTS
(METROPOLITAN BOSTON REGION)

TABLE F-4

Through I&M implementations, the following reductions are anticipated for the Metropolitan Boston region:
(in kg/day for all Mobile Sources)

1983

NMOC

No I&M : 113,200

With I&M: 110,000

= -2.8%

CO

No I&M : 1,490,000

With I&M: 1,426,000

= -4.3%

1984

NMOC

No I&M : 74,900

With I&M: 60,200

= -20%

CO

No I&M : 1,281,000

With I&M: 924,000

= -28%

MASS. I&M PROGRAM

TABLE F-5

Non-methane HC (or NMOC) - 191.3 tons/yr. = 631.1 kg/day

Exhaust CO - 2,929.2 tons/yr. = 9,633.0 kg/day

Exhaust NOx - 242.6 tons/yr. = 800.3 kg/day

Lead - 4.7 tons/yr. = 15.5 kg/day

Regional Emission Increases Due to Fare Increases in Kilograms Per Day for Comparison

Table F-6

APPENDIX F - 2 : Estimation Procedure of Transit Diversions to Other Modes.

F-2 DIVERSION ANALYSIS*

The effects of the August 1981 fare increase, together with the ridership changes due to the 1980 fare increase, are expected to be a net decrease in daily passenger trips of approximately 85,000. This figure represents 42,500 round trips, of which roughly 24,000 (57%) are peak trips and 18,500 (43%) are off-peak.

Under the assumption that trips from the same area would exhibit similar behavior, the diverted trips have been disaggregated based on their assumed origins. The trips were divided into those made within the downtown, those made within the core, excluding the downtown, and those core-bound trips originating outside the core. The core area is defined as East Boston, Charlestown, Chelsea, Everett, Somerville, Cambridge, Brighton, part of Brookline, Roxbury, North Dorchester, and South Boston. The distribution of trips in each category is taken from the 1977 Program for Mass Transit (PMT).

Diverted trips were allocated to the core and corridors based on the percent of total existing transit trips that originate in each area. The only exception was that the diverted trips were skewed somewhat toward the downtown-to-downtown and core-to-core trips to reflect the assumption that a higher percentage of short trips than long trips will be lost. (See Table F-7.)

Within each geographic category, the diverted transit trips then had to be assigned to alternate modes or trip-making behaviors. The alternatives included: taxi, automobile, commuter rail, private bus, walk/bike, other destination, and no trip. The percent of the travel in each category assigned to each mode is based largely on the relative accessibility of the alternative modes. Trip purposes, average trip lengths, automobile ownership, and other factors were also considered. (See Table F-8.)

Three modes needed to be considered in the calculation of new VMT. These are automobile, taxi, and "other destination". All trips assigned to the "other destination" category are assumed to be made by automobile. Combining the mode split for diversions with the number of diverted trips yields a breakdown of diverted passenger trips by automobile for each area. (See Table F-9.)

In order to convert these trips into VMT, trip lengths and vehicle occupancies must be diverted. Automobile occupancies were assumed to be 2.3 and 1.6 for peak and off-peak, respectively.

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*Discussion from CTPS memorandum prepared by Katrina Kalish, "Estimates of Diversions of Transit Users to Other Modes," February 15, 1982.

GEOGRAPHIC DISTRIBUTION OF LOST TRIPS

	Percent of Total	Percent of Lost Trips	Number of Lost Trips
North Shore	7.6	6.7	5700
North	11.4	10.1	8600
Northwest	10.4	9.0	7600
West	11.3	10.1	8600
Southwest	10.1	9.0	7600
South Shore	17.9	15.7	13300
Within Downtown	8.2	16.4	14000
Within Core	23.1	23.1	19600
	100%	100%	85000

Source: C.T.P.S. Memorandum, Estimate of Diversion of Transit Users to Other MOdes Due to the 1981 MBTA Fare Increase. Feb.15, 1982.

GEOGRAPHIC DISTRIBUTION OF LOST TRIPS

TABLE F- 7

DIVERSIONS TO OTHER MODES FROM TRANSIT

(Rows total to 100.0)

	No Trip	Other Dest.	Walk/ Bike	Private Bus	Comm. Rail	Auto	Taxi
North Shore	10	15	5	10	15	45	-
North	10	15	5	5	15	50	-
Northwest	10	15	5	5	15	50	-
West	10	15	5	10	10	50	-
Southwest	10	20	5	5	20	40	-
South Shore	10	15	5	15	-	55	-
Within Downtown	20	5	35	-	-	15	25
Within Core	20	10	15	-	-	45	10

Source: C.T.P.S. Memo, Estimate of Diversion of Transit Users to Other Modes due to the 1981 MBTA Fare Increase, Feb.15, 1981.

DIVERSIONS TO OTHER MODES FROM TRANSIT

TABLE F-8

	Taxi	Auto	Other Destination
North Shore	--	2,560	850
North	--	4,290	1,280
Northwest	--	3,820	1,150
West	--	4,290	1,280
Southwest	--	3,060	1,530
South Shore	--	7,330	2,000
Within Downtown	3,500	2,090	700
Within Core	2,000	8,840	1,960

Source: C.T.P.S.

TABLE F.- 9

GEOGRAPHIC DISTRIBUTION OF PASSENGER TRIPS DIVERTED TO AUTOMOBILE

	VMT By Taxi	VMT By Auto	VMT to Other Destinations	TOTAL
North Shore		14,400	4,400	18,800
North		24,100	6,800	30,900
Northwest		21,600	6,000	27,600
West		24,100	6,800	30,900
Southwest		17,300	8,100	25,400
South Shore		41,300	10,500	51,800
Within Downtown	7,000	1,800	800	9,600
Within Core	9,800	19,200	6,100	35,100
				230,100

Source: C.T.P.S.

TABLE F-10

GEOGRAPHIC DISTRIBUTION OF DIVERTED VMT/DAY

Downtown trips - 2 miles (based on average taxi trip length)

Core trips - 2 miles

Regional Home Based Work trips - 13.4 miles

Regional Non-work trips - 8.46 miles

The following calculations were used to remove the influence of downtown and core trips on the regional Home Based Work and Non-work trip lengths:

PMT Trip Distribution		
	CBD to CBD	2.2%
	Core to Core	16.9%
	Corridor to Core	80.9%

Corridor Home Based Work Trip Lengths

Regional components (trip length x percent of region)

$$(.022 \times 2) + (.169 \times 5) + (.809 \times L) = 13.4 \text{ miles}$$
$$.809L = 12.5 \text{ miles}$$
$$L = 15.5 \text{ miles}$$

Corridor Non-Work Trip Lengths

$$(.022 \times 2) + (.169 \times 5) + (.809 \times L) = 8.46 \text{ miles}$$
$$.809L = 7.6 \text{ miles}$$
$$L = 9.4 \text{ miles}$$

A SUMMARY OF TRIP LENGTH ASSUMPTIONS USED

TABLE F-11

This reflects the belief that most commuters who leave the transit system because of a fare increase will not drive alone. Trips by car to other destinations were assumed to have occupancy rates of 1.6, while taxis were assigned a single passenger each. EOTC has established a carpool occupancy rate of 2.5 persons (Analysis of Transportation of Massachusetts Third Party Vanpool Program, August 1980).

One-way trip lengths were based on area of origin, time of day (peak or off-peak), type of tripmaker (student or other), and destination (core or other). Trips within downtown were assumed to have an average trip length of two miles; the Transportation Element of the State Implementation Plan (TE/SIP) cited this as the average length of downtown taxi trips. "Within Core" trips were estimated to have an average length of five miles based on an average distance from the outer core areas to the downtown. Several trip lengths were used for trips from the corridors to the core. These were based on regional trip lengths cited in the TESIP, adjusted by using two- and five-mile averages for those trips within the region that occurred within the core and the downtown. For instance, the regional home-based work trip length was 13.4 miles; weighting this using two and five miles for downtown and core trips leaves a corridor-to-core trip length of 15.5 miles. Off-peak trips by automobile and both peak and off-peak trips to other destinations had estimated trip lengths of 9.4 miles. The figures were adjusted for students and children who were assumed to make shorter trips averaging three miles based on likely schoolbound trip lengths.

Based on the estimated number of diverted trips, the mode splits, the trip lengths, and the vehicle occupancies, the increases in daily VMT are predicted and displayed in Table SF-10 and F-11.

The net result is thus an additional 230,100 daily VMT or approximately 69.0 million VMT annually. This represents an increase of roughly 0.5 percent of regional daily VMT.

Sources: Trip Purposes: EOTC Staff Report #1, Transportation Needs-Transportation Services, Section IV "Demographic and Travel Characteristics."

Auto Ownership: EOTC Staff Report #1, Section II "Population Characterisitcs"

Trip Length: 1978 TE/Sip, Appendix E.

Sample VMT Calculation (North Corridor)

Lost Trips:	8,580
Trips Lost to Auto:	4,290
Trips Lost to Other Destinations:	1,280

Increased Auto VMT

Trips Lost to Autos	Child Trips (x .15)	Child Trip Miles (x 3.0)	Peak Adult Trips (x .48)	Peak Adult Miles (x 15.5)	Off-Peak Adult Trips (x .37)	Off-Peak Adult Miles (x 9.4)	Apply Occupancy Rate			Total Additional Auto VMT
							Child ÷ 2	Peak Adult ÷ 2.3	Off-Peak Adult ÷ 1.6	
4,290	643	1,930	2,059	31,917	1,587	14,920	965	13,876	9,325	24,166

Increased Other Destination VMT

Trips Lost to Other Destinations	Adult Trips (All Periods) (x .85)	Adult Trip Miles (x 9.4)	Child Trips (x .15)	Child Trip Miles (x 3.0)	Occupancy Rate 1.6		Total Additional Other Destination VMT
					Child	Adult	
1,280	1,088	10,227	192	576	360	6,391	6,751

Source: CTPS Project Files

TABLE F-12

SAMPLE CALCULATION OF VMT CHANGES DUE TO DIVERSIONS

F-3 QUEUING ANALYSIS

It has been assumed that the MBTA fare increase will cause automobile use to increase. Additional volumes of traffic on the radial highways into Boston would, in turn, cause queue lengths to increase.

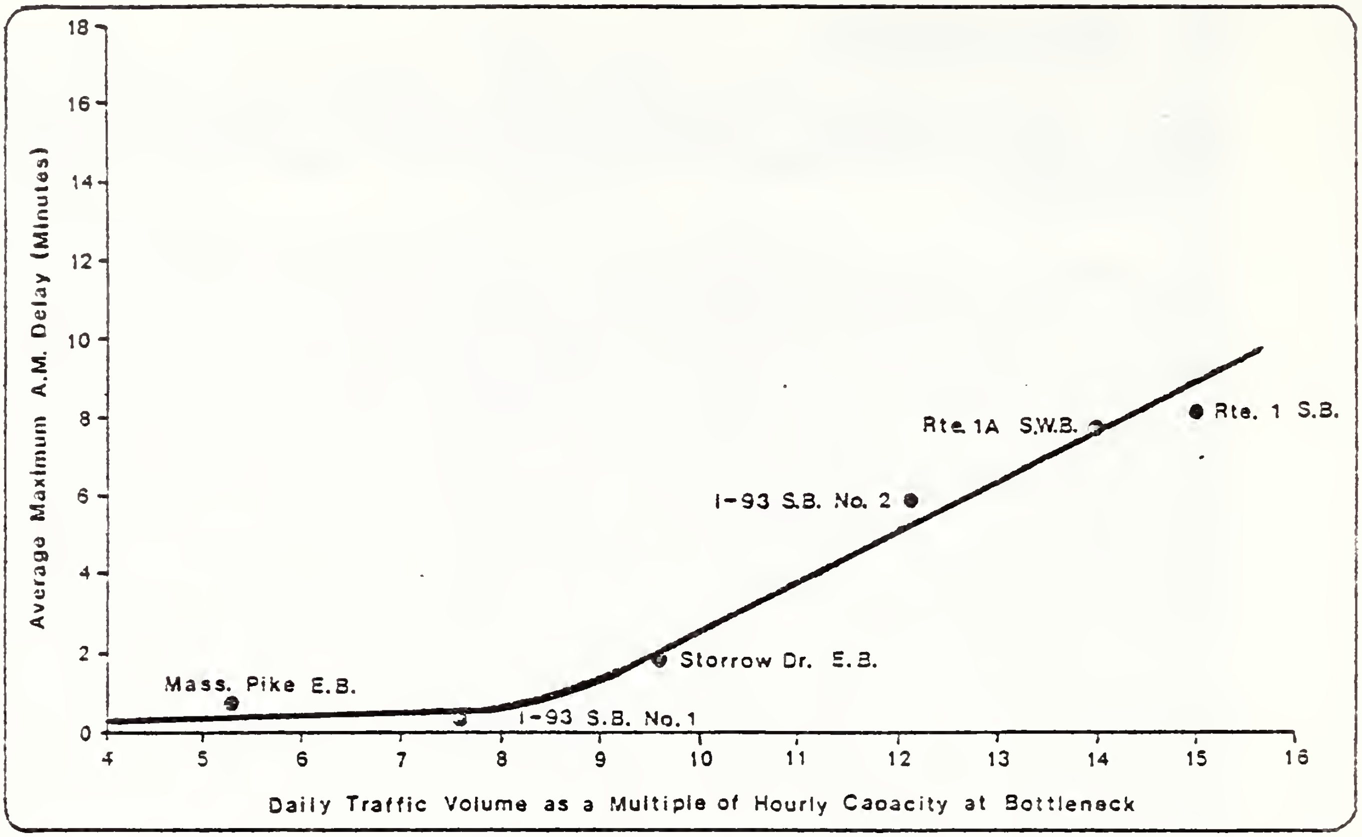
This section takes up the question of estimating increased queue lengths for AM and PM peak trips, respectively, to and from the Boston central area. Further, this section will examine the resulting energy and fuel consumption consequences of congestion. For this purpose, an expressway queuing model developed recently by CTPS will be used. The model predicts AM inbound and PM outbound queuing delays on express highway facilities based on daily traffic volumes relative to capacities at bottleneck points. The delay curves developed and used in the model for AM and PM peaks are shown in Figure F-1 and Figure F-2 As seen in the figures, bottleneck delays begin for both AM and PM peaks when daily traffic volumes at bottleneck points approach eight to ten times hourly capacity. During the morning peak period, delays increase at a rate of 1.25 minutes for every increase in daily traffic equal to hourly bottleneck capacity. During the evening peak, delays increase twice as quickly, increasing at a rate of 2.50 minutes for every increase in daily traffic equal to hourly bottleneck capacity.

In order to apply the curves of Figures F-1 and F-2 in estimating increased queue lengths, increased automobile trips have been estimated by corridor and assigned to facilities as shown in Table F-13. The actual delay calculations are shown in Table F-14 for the AM peak and in Table F-15 for the PM peak. It was estimated that the average maximum delay is measured based on the queue speed and length of time to traverse bottlenecks versus the normal free-flow speed required to traverse the same distance. (Figured on the basis of time/mile at zero volume speed.) As shown in the tables, average delays increase about one-quarter minute during the AM peak and about one-half minute during the PM peak. These delay increases apply to all vehicles on the radial routes, not just the new ones. Figure F-3 shows calculations for both delay-based and acceleration/deceleration-based modeling of total increase in gasoline use through queuing delays.

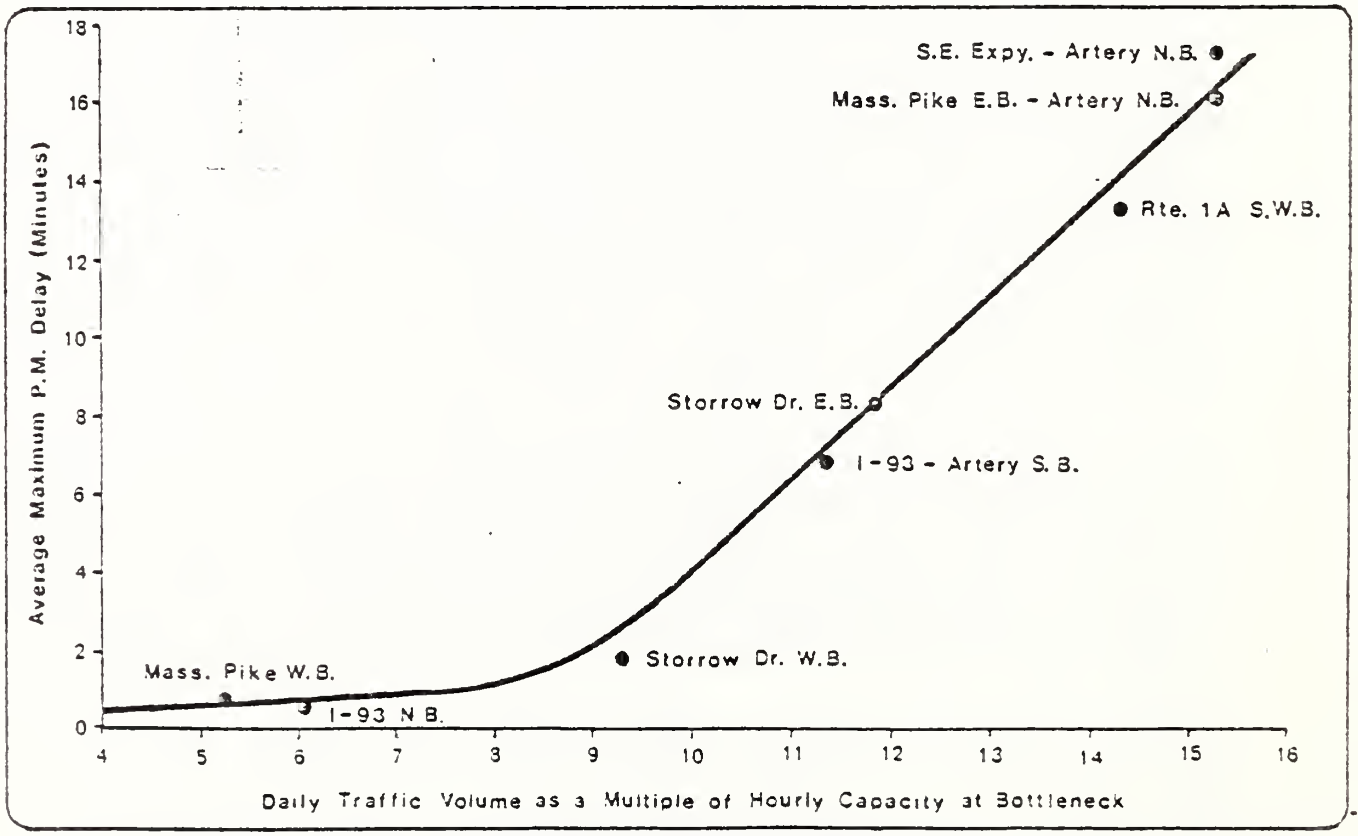
Queue length changes range from 35 feet to about one-half mile. The larger changes in queue lengths shown for Storrow Drive and the Southeast Expressway are not due to extraordinary traffic changes, but to the fact that these facilities do not have explicit queues. For example, the Southeast Expressway is not technically a queue but a stop-and-go level-of-service "F" roadway. Since these two roadways have base case speeds which are faster, it takes more distance to generate a given amount of delay increase.

The actual procedure used in calculating delay and queue increases is as follows. (Refer to Tables F-14 and F-15)

Line 1: Hourly Bottleneck Capacity. Hourly capacity at bottleneck point; estimated to be 10 times the hourly capacity at a given service level.



DAILY TRAFFIC VOLUME AS A MULTIPLE OF HOURLY CAPACITY AT BOTTLENECK VS. AVERAGE MAXIMUM A.M. PEAK DELAY	Figure F-1



DAILY TRAFFIC VOLUME AS A MULTIPLE OF HOURLY CAPACITY AT BOTTLENECK VS. AVERAGE MAXIMUM P.M. PEAK DELAY	Figure F-2

(Delay-based)

.6 gallons/hour used idling

AM .0025 gallons used every 155 seconds
.0025 x 270,614 = 677 gallons/morning peak

PM .005 gallons every 30 seconds
.005 x 259,380 = 1,297 gallons/evening peak

1,974 gallons/day x 260 = 513,240 gallon/yr.
(workdays/year)

513,240 11% increase over 4.7 million gallons/year

(Acceleration/Deceleration-based)

30-10-30 cycle .0035
45-14-45 cycle .005

(average of zero volume speed - average queue speed - average zero volume speed)

AM .005 x 270,614 = 1,353
PM .005 x 259,380 = 1,297
2,650 gallons/day

2,650 gpd x 260 = 689,000 gallons/year
(workdays/year)

689,000 15% increase over 4.7 million gallons/year

ESTIMATION OF INCREASED GASOLINE CONSUMPTION THROUGH QUEUING DELAYS

FIGURE F-3

Origin	Number	Assigned Route
East Boston	100	Sumner Tunnel
Chelsea	120	Rte. 1, Tobin Bridge
Cambridge	380	Storrow Drive (Memorial Dr.)
Brighton	270	Storrow Drive (Memorial Dr.)
No. Dorchester	90	Southeast Expressway
North Shore	1,370	80% Rte. 1, 20% Sumner Tunnel
North	2,210	I-93
Northwest	1,970	50% I-93, 50% Storrow Drive
West	2,210	Mass Pike
Southwest	1,580	50% Mass Pike, 50% S.E. Expressway
South Shore	3,780	Southeast Expressway

I-93 2,210 + 985 = 3,195

Rte. 1 120 + 1,100 = 1,220

Sumner 100 + 270 = 370

S.E. Expressway 90 + 790 + 3,730 = 4,610 → 3,600

Mass Pike 2,210 + 790 = 3,000 → 3,160

Storrow Drive 380 + 270 + 985 = 1,635 → 1,070

Modifications due to congestion

S.E. Expressway: divert 1010 to arterials
Mass Pike: accept 160 from Storrow Drive
Storrow Drive: divert 10% (1,601) to Mass Pike and 25% (405) to Memorial Drive

Estimated and Assigned Additional Inbound Automobiles Resulting From MBTA Fare Increase

Table F-13

		Central Artery to I-93 & Rte. 1	Storrow Drive to I-93 & Rte. 1	Callahan Tunnel	Southeast Expressway	Mass Turnpike	Storrow Drive
1	Hourly Bottleneck Capacity[1]	2,800	2,200	3,100	8,000	8,400	3,400
2	Base Case AWDT	42,619	25,960	41,034	74,479	43,371	31,416
3	Base Case Daily Volume, Hourly Capacity	15.22	11.80	13.24	9.31	5.22	9.24
4	Base Avg. Max. Delay	~17½ min.	~8½ min.	in other queues	Varies	--	~2 min.
5	Daily Traffic Increase	2,740[3]	1,675[3]	370	3,655	3,660	1,079
6	New AWDT	45,359	27,635	41,404	78,134	47,031	32,489
7	New DV ÷ HC	16.20	12.56	13.36	9.77	5.71	9.56
8	Change DV ÷ HC	0.98	0.78	0.12	0.46	0.38	0.31
9	Change in Average Max. Delay[2]	2.45	1.90	0.44	1.14	--[4]	0.74
10	1/2 Δ Avg. Max. Delay[5]	1.22	0.95	0.22	0.57	--	0.39
11	Zero Volume Speed	50	40	40	55	55	40
12	Time/Mile at Z.V.S.	1.200	1.500	1.500	1.091	1.091	1.500
13	Avg. Queue Speed	10	5	5	25	55	25
14	Queue Time Per Mile	6.000	12.000	12.000	2.400	1.091	2.400
15	Δ Time/Mile in Queues	4.800	10.500	10.500	1.309	--	.900
16	Δ Miles of Queue	0.254	0.905	0.021	.435	--	.433
17	Δ Feet of Queue	1.342	478	111	2.297	--	2.288
18	Base Case 4-Hour Traffic	11,525	8,080	10,495	26,584	16,250	10,375

[1] Defined as 10 times hourly capacity at bottleneck point.

[2] Based on 25.0 minutes added delay per 1.0 increase in V/C (Delay Model 3C).

[3] Based on 62%/33% split on Rte. 1 and I-93 assumed Traffic from Central Artery & Storrow Drive.

[4] Below threshold rate for delay increases.

[5] Assuming average delay is one-half average maximum delay.

EXPRESSWAY QUEUING IMPACTS OF 1981 MBTA FARE INCREASE -- AM PEAK PERIOD

TABLE F-14

		Central Artery to I-93 & Rte. 1	Storrow Drive to I-93 & Rte. 1	Callahan Tunnel	Southeast Expressway	Mass. Turnpike	Storrow Drive
1	Hourly Bottleneck Capacity[1]	2,800	2,200	3,100	8,000	8,400	3,400
2	Base Case AWDT	42,619	25,960	41,034	74,479	43,871	31,416
3	Base Case Daily Volume, Hourly Capacity	15.22	11.80	13.24	9.31	5.22	9.24
4	Base Avg. Max. Delay	~17½ min.	~8½ min.	in other queues	Varies	--	~2 min.
5	Daily Traffic Increase	2,740[3]	1,675[3]	370	3,655	3,160	1,079
6	New AWDT	45,359	27,635	41,404	78,134	47,031	32,459
7	New DV ÷ HC	16.20	12.56	13.36	9.77	5.71	9.56
8	Change DV ÷ HC	0.98	0.78	0.12	0.46	0.38	0.31
9	Change in Average Max. Delay[2]	2.45	1.90	0.44	1.14	--[4]	0.74
10	1/2 Δ Avg. Max. Delay[5]	1.22	0.95	0.22	0.57	--	0.39
11	Zero Volume Speed	50	40	40	55	55	40
12	Time/Mile at Z.V.S.	1.200	1.500	1.500	1.091	1.091	1.500
13	Avg. Queue Speed	10	5	5	25	55	25
14	Queue Time Per Mile	6.000	12.000	12.000	2.400	1.091	2.400
15	Δ Time/Mile in Queues	4.800	10.500	10.500	1.309	--	.900
16	Δ Miles of Queue	0.254	0.905	0.021	.435	--	.433
17	Δ Feet of Queue	1,342	478	111	2,297	--	2,288
18	Base Case 4-Hour Traffic	11,525	8,080	10,495	26,584	16,250	10,375

[1] Defined as 10 times hourly capacity at bottleneck point.

[2] Based on 25.0 minutes added delay per 1.0 increase in V/C (Delay Model 3G).

[3] Based on 62%/33% split on Rte. 1 and I-93 assumed Traffic from Central Artery & Storrow Drive.

[4] Below threshold rate for delay increases.

[5] Assuming average delay is one-half average maximum delay.

EXPRESSWAY QUEUING IMPACTS OF 1981 MBTA FARE INCREASE -- PM PEAK PERIOD

TABLE F-15

Key to Table 15

Line 2: Base Case AWDT. Actual daily volume at bottleneck point before fare increase.

Line 3: Base Case Daily Volume Divided by Hourly Capacity. Line 1 divided by Line 2.

Line 4: Base Case Average Maximum Delay. From Figure 1 and Figure 2, from values of daily volume divided by hourly bottleneck capacity.

Line 5: Daily Traffic Increase. From Table 5.

Line 6: New AWDT. Line 2 plus Line 5.

Line 7: New Daily Traffic Divided by Hourly Capacity. Line 6 divided by Line 1.

Line 8: Δ Daily Traffic Divided by Hourly Capacity. Line 7 minus Line 3.

Line 9: Δ Average Maximum Delay. Line 8 multiplied by 1.25 for AM peak; 2.50 for PM peak.

Line 10: One-Half Δ Average Maximum Delay. Line 9 divided by two. Assumes that the average vehicle during the peak period encounters one-half the average maximum delay.

Line 11: Zero Volume Speed. Speed of the relevant section of highway when conditions are uncongested. Source: CTPS Speed Runs.

Line 12: Time Per Mile at Zero Volume Speed. Time taken by a vehicle to traverse a mile of the relevant section of highway with uncongested conditions:

$$\left(\frac{1}{\text{Zero Volume Speed}} \times 60\right)$$

Line 13: Average Queue Speed. Typical speed on the relevant section of highway under conditions of queuing. Source: CTPS Speed Runs.

Line 14: Queue Time Per Mile. Time taken by a vehicle to traverse a mile of the relevant section of highway under queued conditions:

$$\left(\frac{1}{\text{Queue Speed}} \times 60\right)$$

Line 15: Δ Time Per Mile in Queue. Line 14 minus Line 12.

Line 16: Δ Miles of Queue. The number of miles of queue necessary to increase delay by the amount shown on Line 10. Line 10 divided by Line 15.

Line 17: Δ Feet of Queue. Line 16 times 5,280.

Line 18: Base Case Four-Hour Traffic. From MDPW traffic counts.

From Tables F-14 and F-15, the increased queue lengths of Line 16 and 17 may be applied to the peak period vehicles of Line 18 to calculate energy/air quality changes, using changes in vehicle speeds from those of Line 11 to those of Line 13.

F-4 THE ENERGY CONSEQUENCES OF TRAFFIC CONGESTION

Traffic congestion will increase the original yearly estimate of motor fuel consumption (caused by the fare increase) by 11% to 15%(see Figure F-3). Assuming each car undergoes an additional 15-second delay in the peak AM and a 30-second delay in the peak PM, gasoline consumption, based on a rate of .6 gallons/hour used idling,* would increase by 677 gallons each morning and 1,297 gallons each evening. Of course, the assumption here is that the respective delays are accounted for in vehicle idling. Based on a 260-day work year, another 513,240 gallons of fuel would be used (11%).

Deceleration and re-acceleration also uses extra fuel over and above constant cruising speed. A 30mph — 10mph — 30mph cycle results in increased gas consumption of .0035 gallons over steady cruising speed. The average drop in zero volume speed to queuing speed at bottleneck points averages over 30mph (45-14)** during morning and evening peaks. (Idling time is not figured in, but appears in the average queue speed.) Reattainment of cruising speed in these vehicles would probably consume more than .0035 gallons. Assigning a value of .005 extra gallons for a net 30mph acceleration/deceleration/acceleration cycle yields, over a work day, a figure of 689,000 (15%) additional gallons consumed. This is a "soft" figure and probably less accurate than the "delay-based" figure for two reasons:

(1) Some acceleration/deceleration cycle was present at bottleneck points before the delay, and

(2) It is impossible to determine at what point in time acceleration and deceleration occur. Some vehicles may decelerate at end of trip and never resume cruising speed.

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*Guidelines to Reduce Energy Consumption Through Transportation Actions, UMTA, May 1974, p. 4-51.

**Not including Mass Pike (no bottleneck).

F-5 THE MARGINAL ENERGY CONSEQUENCES OF CHANGES IN REVENUE MILEAGE

As was discussed in Section 2.8.1., a significant portion of systemwide energy use is unaffected by total vehicle mileage. The following calculation demonstrates the effect on the MBTA system energy efficiency associated with 10 percent increase in rail vehcicle revenue mileage:

1981	35,711,187	Rev. Miles (Rail & Bus)	$3,914,565 \times 10^6$ BTU
1982 (10% Increase)	39,282,305	Rev. Miles (Rail & Bus)	$921,679 \times 10^6$ BTU 48,643
		Elec.	853,830 (Non-Traction) 2,299,454 (Traction)
		TOTAL	$4,123,606 \times 10^6$ BTU

1981 $\frac{35,711,187}{3,914,565} \times 0.125701 = 1.1467$ MPG

1982 (10% Increase Mileage) $\frac{39,282,305}{4,123,606} \times 0.125701 = 1.19745$ MPG

$\frac{1.1467-1.1975}{1.1467} \times 100\%$: 4.4% Improvement in Energy Efficiency Systemwide with 10% Increase in Rail Vehicle Miles

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10% Increase Mileage = 3,571,119 Miles

Assume 4.29 Passengers/Mile = 15,320,100 Increased Passengers

This indicates that the marginal energy efficiency of increased mileage in the system is great and produces significant increases in systemwide efficiency as well.

F-6 EMISSION FACTORS FOR HYDROCARBON COMPOUNDS, CARBON MONOXIDE, AND OXIDES OF NITROGEN

With the exception of lead calculatons, the emission factors used throughout the air quality analysis are from MOBILE2, an EPA computer program that calculates emission factors in grams per mile for various pollutants, including HC, CO, and NO_x. Calculations referring to total hydrocarbons (HC) in the analysis were based on the reactive hydrocarbons (non-methane hydrocarbons or NMHC), the principal hydrocarbons found in auto emissions. The factors were supplied to CTPS by DEQE and were adjusted to reflect the Massachusetts vehicle fleet.

Factors were obtained for several speeds: 5, 10, 25, 27, 30, 39, 40, 50, and 55 mph. Five, 10, and 25 mph were used to reflect speeds for queues on selected highways; 40, 50, and 55 mph reflect free flow speeds on highways; 27, 30, and 39 mph reflect speeds used for within downtown, within core, and corridor-to-core trips, respectively, based on speeds associated with appropriate functional classifications.

The proportions of vehicles operating in cold start (20.6 percent), hot start (27.3 percent), or hot stabilized (52.1 percent) conditions were assumed to be the national average default values for the regional emissions analysis and the PM peak period queuing analysis. All automobiles were assumed to be operating in the hot stabilized mode for the AM peak period queuing analysis. Ambient temperatures that represent worst-case conditions were used: 75°F for HC and NO_x, and 20°F for CO.

Lead emissions were calculated in a different manner, as is presented in Appendix Section F- 7.

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COMPOSITE EMISSION FACTORS (GM/MILE)
NO-MTH HC:  4.71   4.33   5.64   4.78  14.83    .67    .88   4.06   7.82   5.13
EXHST  CO: 48.86  43.34  47.68  44.84 224.41   1.50   2.02  12.51  28.71  54.01
EXHST NOX:  3.12   3.30   3.97   3.53  10.09   1.56   1.83  25.12    .52   4.15

HOT STABILIZED IDLE EMISSION FACTORS (GM/MIN)
NM-ID  HC:    .79    .62    .70    .65   1.02    .04    .10    .35   1.38    .77
 IDLE  CO: 14.02  10.71   9.07  10.15   9.90    .19    .34    .89   3.69  12.73
 IDLE NOX:    .19    .09    .07    .08    .06    .20    .32    .92    .02    .19
------------------------------------------------------------------------------

 CAL. YEAR: 1980      REGION: 49-STATE LOWALT.          ALT:  500. FT.
                        TAMB: 75.0(F)        30.0/ 27.3/ 30.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
VEH. SPD.: 24.0   24.0   24.0          24.0   24.0   24.0   24.0   24.0
  VMT MIX:   .778   .087   .046          .042   .005   .001   .033   .009

COMPOSITE EMISSION FACTORS (GM/MILE)
NO-MTH HC:  4.33   3.99   5.14   4.38  12.98    .61    .80   3.65   7.29   4.68
EXHST  CO: 43.28  38.60  41.95  39.76 194.02   1.30   1.75  10.86  25.61  47.64
EXHST NOX:  3.28   3.48   4.13   3.71  10.36   1.49   1.74  23.94    .55   4.27

HOT STABILIZED IDLE EMISSION FACTORS (GM/MIN)
NM-ID  HC:    .79    .62    .70    .65   1.02    .04    .10    .35   1.38    .77
 IDLE  CO: 14.02  10.71   9.07  10.15   9.90    .19    .34    .89   3.69  12.73
 IDLE NOX:    .19    .09    .07    .08    .06    .20    .32    .92    .02    .19
------------------------------------------------------------------------------

 CAL. YEAR: 1980      REGION: 49-STATE LOWALT.          ALT:  500. FT.
                        TAMB: 75.0(F)        30.0/ 27.3/ 30.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
VEH. SPD.: 27.0   27.0   27.0          27.0   27.0   27.0   27.0   27.0
  VMT MIX:   .778   .087   .046          .042   .005   .001   .033   .009

COMPOSITE EMISSION FACTORS (GM/MILE)
NO-MTH HC:  4.00   3.69   4.71   4.04  11.55    .55    .72   3.31   6.86   4.31
EXHST  CO: 38.45  34.36  37.09  35.30 171.10   1.15   1.55   9.59  23.12  42.27
EXHST NOX:  3.42   3.66   4.28   3.87  10.62   1.44   1.68  23.11    .58   4.39

HOT STABILIZED IDLE EMISSION FACTORS (GM/MIN)
NM-ID  HC:    .79    .62    .70    .65   1.02    .04    .10    .35   1.38    .77
 IDLE  CO: 14.02  10.71   9.07  10.15   9.90    .19    .34    .89   3.69  12.73
 IDLE NOX:    .19    .09    .07    .08    .06    .20    .32    .92    .02    .19
------------------------------------------------------------------------------

 CAL. YEAR: 1980      REGION: 49-STATE LOWALT.          ALT:  500. FT.
                        TAMB: 75.0(F)        30.0/ 27.3/ 30.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
VEH. SPD.: 30.0   30.0   30.0          30.0   30.0   30.0   30.0   30.0
  VMT MIX:   .778   .087   .046          .042   .005   .001   .033   .009

COMPOSITE EMISSION FACTORS (GM/MILE)
NO-MTH HC:  3.72   3.42   4.35   3.74  10.44    .50    .66   3.03   6.48   3.99
EXHST  CO: 34.26  30.61  32.92  31.41 153.91   1.03   1.39   8.60  21.02  37.72
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VEH. SPD.: 55.0   55.0   55.0          55.0   55.0   55.0   55.0   55.0
  VMT MIX:   .778   .087   .046          .042   .005   .001   .033   .009

COMPOSITE EMISSION FACTORS (GM/MILE)
NO-MTH HC:  2.78   2.57   3.09   2.75   7.11    .34    .45   1.95   5.21   2.94
EXHST  CO: 22.01  20.15  20.32  20.21 137.53    .79   1.05   6.59  14.02  25.69
EXHST NOX:  4.03   4.41   4.94   4.59  13.08   1.91   2.24  30.76    .70   5.32

HOT STABILIZED IDLE EMISSION FACTORS (GM/MIN)
NM-ID  HC:    .79    .62    .70    .65   1.02    .04    .10    .35   1.38    .77
 IDLE  CO: 14.02  10.71   9.07  10.15   9.90    .19    .34    .89   3.69  12.73
 IDLE NOX:    .19    .09    .07    .08    .06    .20    .32    .92    .02    .19
------------------------------------------------------------------------------

 CAL. YEAR: 1980      REGION: 49-STATE LOWALT.          ALT:  500. FT.
                        TAMB: 75.0(F)        30.0/ 27.3/ 30.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
VEH. SPD.: 15.0   15.0   15.0          15.0   15.0   15.0   15.0   15.0
  VMT MIX:   .778   .087   .046          .042   .005   .001   .033   .009

COMPOSITE EMISSION FACTORS (GM/MILE)
NO-MTH HC:  5.82   5.30   7.11   5.93  20.42    .85   1.12   5.14   9.48   6.43
EXHST  CO: 65.02  56.31  64.75  59.23 318.58   2.09   2.81  17.42  38.89  72.66
EXHST NOX:  2.82   2.93   3.63   3.17   9.56   1.79   2.09  28.74    .47   3.97

HOT STABILIZED IDLE EMISSION FACTORS (GM/MIN)
NM-ID  HC:    .79    .62    .70    .65   1.02    .04    .10    .35   1.38    .77
 IDLE  CO: 14.02  10.71   9.07  10.15   9.90    .19    .34    .89   3.69  12.73
 IDLE NOX:    .19    .09    .07    .08    .06    .20    .32    .92    .02    .19
------------------------------------------------------------------------------

 CAL. YEAR: 1980      REGION: 49-STATE LOWALT.          ALT:  500. FT.
                        TAMB: 75.0(F)        30.0/ 27.3/ 30.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
VEH. SPD.: 18.0   18.0   18.0          18.0   18.0   18.0   18.0   18.0
  VMT MIX:   .778   .087   .046          .042   .005   .001   .033   .009

COMPOSITE EMISSION FACTORS (GM/MILE)
NO-MTH HC:  5.18   4.75   6.26   5.27  17.24    .76    .99   4.55   8.50   5.68
EXHST  CO: 55.69  48.92  54.83  50.97 264.74   1.76   2.36  14.64  32.85  61.92
EXHST NOX:  2.97   3.11   3.80   3.35   9.83   1.66   1.95  26.70    .49   4.05

HOT STABILIZED IDLE EMISSION FACTORS (GM/MIN)
NM-ID  HC:    .79    .62    .70    .65   1.02    .04    .10    .35   1.38    .77
 IDLE  CO: 14.02  10.71   9.07  10.15   9.90    .19    .34    .89   3.69  12.73
 IDLE NOX:    .19    .09    .07    .08    .06    .20    .32    .92    .02    .19
------------------------------------------------------------------------------

 CAL. YEAR: 1980      REGION: 49-STATE LOWALT.          ALT:  500. FT.
                        TAMB: 75.0(F)        30.0/ 27.3/ 30.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
VEH. SPD.: 21.0   21.0   21.0          21.0   21.0   21.0   21.0   21.0
  VMT MIX:   .778   .087   .046          .042   .005   .001   .033   .009
```

TABLE F-16 Example of the MOBILE II Emission Factors Program Output

F-7 CALCULATION OF LEAD EMISSIONS

The composite lead emission factor is the sum of the products of fraction of annual travel per vehicle model year, fuel consumption expressed as gallons/mile, lead concentration expressed in grams/gallon and the fraction of lead emitted.

Figures derived from this calculation are treated as a general measure of vehicular lead emission; however, environmental and atmospheric factors and vehicle characteristics will affect the amount and location of total atmospheric lead.

I. Travel Fraction

Travel fraction is the percentage of annual travel for each vehicle (by model year) registered in Massachusetts, expressed as a fraction of the total sum of vehicle miles driven by registered cars in the state.

II. Fuel Consumption

Fuel consumption is one of the factors in the lead emission equation that is subject to interpretation. Fuel economy figures used in this analysis are based on figures used by Provenzano in a Journal of the Air Pollution Control Association article and are based on fuel economy figures calculated by Consumer Reports magazine. These values were derived from an examination of the fuel economy of the vehicle fleet in tests modeling actual road conditions.

Provenzano's estimates* of fuel economy per model year (city and highway) averaged about 15 percent lower than EPA estimates. That same 15 percent differential was used to estimate recent fuel economy estimates not directly provided by Provenzano. Figures for before 1967 are an average of 1967 to 1972 figures when fuel economy deviated very little from year to year. For purposes of the lead emission equation, fuel economy was expressed in gallons/mile.

III. Lead Concentration in Gasoline

Lead concentrations in gasoline, as several reports suggest, vary according to seasonal, geographical, and regulatory considerations. Unleaded gasolines after 1975 were defined as those having less than .05 grams/gallon of gasoline. Both Provenzano and an EPA study**assume that 95 percent of the autos built from 1975 on require unleaded gas. Figures for average lead concentration per gallon of gas are derived from EPA figures. The significant drop in grams/gallon after 1974 reflects the assumption that 95 percent of vehicles in that model year burned unleaded gas.

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*George Provenzano, "Motor Vehicle Lead Emissions in the U. S.," Journal of the Air Pollution Control Association, p. 1194, December 1978.

**U. S. Environmental Protection Agency, Supplementary Guidelines for Lead Implementation Plans; Revised Section 4.3 (Projecting Automotive Lead Emissions) July 1979.

IV. Fraction of Lead Emitted

Most sources have agreed on the emission factor of .70 for lead-fuel burning vehicles, i.e., 70 percent of the lead burned is exhausted. This figure is used by EPA in their guidelines for protecting automotive lead emissions*. This value was in the range of Provenzano's assigned rates of 60 percent for urban driving and 80 percent for highway driving. According to his study, a substantial amount of lead is retained in the engine, oil, and interior surfaces of the exhaust system when the vehicle is driven at slower speeds. As the vehicle grows older, Provenzano noted, emission rates climb as mileage increases.

The calculations in this report used the .70 figure.

V. Grams Per Vehicle Mile

The product of these factors is a figure for each model year of grams of lead emitted/vehicle mile. The composite of these model years yields an estimated .0676 grams of lead per vehicles mile traveled. Thus, an increase of 230,100 vehicle miles would increase regional lead concentration by about 34 pounds daily.

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*U. S. Environmental Protection Agency, Supplementary Guidelines for Lead Implementation Plans; Revised Section 4.3 (Projecting Automotive Lead Emissions) July 1979.
Other Sources: Airborne Lead Analysis for Highway Projects, Leonard F. Vik, Illinois Department of Transportation, Springfield, Illinois, June 1979.

Year	I Fraction of Annual Travel	II Fuel Consumption Gal./Mile	III Lead Concentration Grams/Gal.	IV Fraction of Lead Emitted	V (a)(b)(c)(d)
1980	.679	.06	.128	.70	.0036
1979	.1153	.06	.152	.70	.0007
1978	.1091	.07	.143	.70	.0008
1977	.0956	.07	.143	.70	.0007
1976	.0934	.07	.147	.70	.0007
1975	.0764	.07	.143	.70	.0005
1974	.0918	.08	2.26	.70	.0116
1973	.0930	.08	2.5	.70	.0130
1972	.0753	.08	2.5	.70	.0105
1971	.0545	.07	2.5	.70	.0067
1970	.0461	.07	2.9	.70	.0066
1969	.0295	.08	2.9	.70	.0048
1968	.0204	.07	2.9	.70	.0029
1967	.0117	.07	2.9	.70	.0017
1966	.0084	.07	2.9	.70	.0012
1965	.0051	.07	2.9	.70	.0007
1964	.0019	.07	2.9	.70	.0003
1963	.0017	.07	2.9	.70	.0002
1962	.0015	.07	2.9	.70	.0002
1961	.0013	.07	2.9	.70	.0002
				Composite	.0676

230,100 VMT x .0676 grams/vehicle mile = 15,554.76 grams/mile or
34.3 lbs./day

LEAD EMISSION CALCULATIONS

TABLE
F-17

F-8 CO HOT SPOT ANALYSIS - PARAMETERS

Carbon monoxide (CO) is a primary pollutant emitted directly by motor vehicles. The highest ambient concentrations can be found in the immediate vicinity of the emission sources, near areas of heavy traffic flow or congestion. The carbon monoxide verification procedure employed by CTPS focuses on the magnitude of CO concentrations that can be expected at a specific location taking into account the factors that directly effect concentrations in the vicinity of an emissions source.

CO Concentrations occurring in the immediate vicinity of a roadway or street can be attributed to two sources--1) a concentration directly attributable to the nearby roadway and 2) a background component that is attributable to all other emission sources. In Boston, a background concentration of 3.0 parts per million has been assumed.

The concentration of CO at any point is primarily a function of three factors: 1) the rate that CO is discharged into the air by the emission sources, 2) the forces that act to disperse the CO emitted into the air, and 3) the receptor location.

1) Emission Rates

The CO emission rates can vary greatly depending on various operational characteristics of the vehicle, such as engine speed, acceleration and deceleration rates, and environmental conditions.

Two emission rates are considered. The first--free-flow emissions--is defined as a constant quantity of emissions produced by a vehicle operating at a relatively constant cruise speed. The second--excess emissions--is that amount in addition to free-flow emissions produced while a vehicle is accelerating, decelerating, or idling.

The traffic environment directly determines the quantity of emissions produced. Some of the more important features of the traffic environment are the physical condition of the roadway or intersection (number of lanes, signals, turning lanes), the density and composition of traffic (number of trucks, number of right and left turns), and the location of the site in question. The various elements collectively determine the capacity of a roadway or intersection. Given this capacity and given traffic volumes, one can develop queue lengths and delay times, important parameters in the CO Hot Spot Analysis.

Another environmental consideration is ambient temperature, since emission rates rise as temperature falls. In doing the CO Hot Spot analysis, the worst-case condition, 20°F, is assumed.

2) Dispersion Characteristics

Local meteorological conditions greatly affect the CO concentrations. Atmospheric conditions can lessen the impact of heavy concentrations or create a Hot Spot where relatively few emissions occur.

The CO concentration is determined in part by the atmospheric stability. The level of turbulence determines the degree of vertical mixing which will occur between CO and the surrounding air. When mixing occurs, CO concentrations fall; when the air is relatively stable, conditions are unfavorable for mixing and CO concentrations rise. In the Hot Spot analysis, low vertical mixing, the worst-case condition, is assumed. Ground level obstructions, such as rough terrain, buildings, trees, and moving vehicles, sometimes create mechanical turbulence which act to increase mixing of CO with the surrounding air.

CO concentrations are inversely proportional to wind speed. As wind speed increases, CO levels fall. For one-hour concentration estimates, a wind speed of one meter per second is assumed; for eight-hour concentration estimates, a speed of three meters per second is assumed. These speeds simulate worst-case conditions.

Finally, wind direction is usually the most important factor affecting CO concentrations at a given location. It is assumed in the Hot Spot procedure that the wind is at an angle to the roadway that yields the highest CO concentration at the receptor site.

3) Receptor Location

To estimate the impact of carbon monoxide at an intersection, concentrations must be measured or estimated at a single-receptor location, chosen so as to register the highest concentrations to which the public would be exposed. An example location would be near the sidewalk nearest the highest volume intersection approach.

In the CO Hot Spot Analysis, the concentration of CO is a relative quantity--the quantity of CO relative to a quantity of ambient air. This is usually expressed as parts of CO per million parts air.

APPENDIX F - 9 : ESTIMATION OF VMT GROWTH

MEMORANDUM

Subject: Proposed Policy on VMT Growth Projections

To: Air Quality Task Force

From: Data Subcommittee DE

Date: February 5, 1981

Action Required: Approval

The Data Subcommittee met on February 3 and dicussed VMT data and projections with representatives of MDPW. The subcommittee concluded that insufficient reliable data exists to derive RPA specific VMT growth rates. For RACM analysis RPAs should adopt the 2.3% statewide annual rate implied by MDPW's 1987 VMT projections and latest revised base year VMT. However, different project specific VMT projections may be used as long as their impacts are not so large as to conflict with RPA-wide use of the statewide rate.

The reasons for this recommendation are the following:

1. No superior alternative exists. Methods suggested by AQTF agencies include estimates by simulation using UTPS type models, and projections from estimates of fuel dispensed at gasoline stations. The Data Subcommittee believes these methods may be potentially less accurate than the MDPW procedure.

2. Historical data is not adequate to establish trends at the regional level and is even suspect as a basis for statewide projections. Previous experience is invalid due to rapid and continuing changes in energy supplies, fuel prices, vehicle fuel economy, and national economic trends. In addition, the inherent error margin in traffic counts used to check VMT figures is 10% or more. According to MDPW, the region specific growth rates prepared by the Planning Branch from 1977-80 data (tables dated 7/9/80) are not significantly different statistically from each other.

3. The 2.3% VMT growth rate was derived from prior estimates of 1987 and 1980 total VMT. MDPW checks VMT projections against traffic counts every two years. As MDPW acquires new data, including information gathered for NECROS, the base VMT figure may be revised, which would change the growth rate required to reach the projected 1987 total VMT. MDPW will reevaluate VMT trends periodically and revise the projected growth rate when necessary.

4. Sensitivity tests by the Planning Branch show that required emissions reductions are only moderately sensitive to the most divergent reasonable assumptions of VMT growth.

It is important to keep in mind that MDPW projects the absolute level of VMT in 1987 and derives a growth rate to reach that level, rather than assuming a growth rate in order to project 1987 VMT. Changes in estimated growth rates are attributable to a revised base year VMT. Since for emissions it is the absolute 1987 VMT that is important, RACM analyses should calculate impacts based on MDPW projected VMT, not on the basis of percentage growth rates, unless the rates used imply the same 1987 total VMT. An outline of the MDPW estimation method is attached.

This policy will not affect the relationship between emission reduction "targets" and RACM impacts. The emission reduction targets are planning goals only and should not be considered as having legal force. The are subject to revision at any time. Target levels should not affect the adoption of RACMs since many other factors enter the decision to implement a project or mix of projects. RACMs must be implemented if they are feasible and effective, irrespective of the current numerical value of a reduction target.

DE/td

DEVELOPMENT OF REVISED ESTIMATE OF 1987 VMT

A. Estimate 1987 vehicle fleet size and composition (statewide).

B. Estimate 1987 fleetwide fuel economy (statewide average = 21.93 mpg).

C. Estimate 1987 fuel consumption for highway uses (statewide consumption for highway uses = 2060 million gallons).

D. From the above data, calculate AVMT for 1987 (statewide = 40.891 billion).

E. For each city/town and functional class, derive 1987 DVMT by applying the ratio of 1987 to 1980 statewide AVMT:

$$\frac{AVMT_{87}}{AVMT_{80}} = 1.1727708$$

$$DVMT_{87} = DVMT_{80} \times 1.1727708$$

F. Calculate annual compound growth rate from 1980 to 1987:

$(1.1727708)^{(1/7)} = 1.023$ or 2.3% annual VMT growth rate.

Appendix F-10 : Annual and Monthly Vehicle Counts (1982) for Selected Major Links

Initial Turnpike

Year	Passenger*	% of Year	Commercial**	% of Year	Non-Revenue	% of Year	Total	% Increase (Decrease)
1973	31,047,262	89.1	3,538,375	10.1	276,668	0.8	34,862,305	4.7
1974	28,968,407	88.7	3,461,345	10.6	228,889	0.7	32,658,641	(6.3)
1975	31,022,287	89.7	3,309,893	9.6	256,849	0.7	34,589,029	5.9
1976	33,286,190	89.4	3,688,371	10.0	240,049	0.6	37,214,610	7.6
1977	35,658,197	89.2	4,034,929	10.1	261,185	0.7	39,954,311	7.4
1978	37,707,148	89.0	4,360,252	10.3	292,559	0.7	42,359,959	6.0
1979	37,493,355	88.5	4,598,609	10.9	269,284	0.6	42,361,248	0.0
1980	37,379,284	88.9	4,426,786	10.5	250,477	0.6	42,056,547	(0.7)
1981	38,514,739	89.0	4,489,566	10.4	255,027	0.6	43,259,332	2.9
1982	41,048,345	89.4	4,567,783	10.0	276,117	0.6	45,892,245	6.1

Boston Extension

Year	Passenger*	% of Year	Commercial**	% of Year	Non-Revenue	% of Year	Total	% Increase (Decrease)
1973	44,586,912	92.8	3,195,130	6.6	284,999	0.6	48,067,041	2.7
1974	42,779,731	92.7	3,115,365	6.8	248,426	0.5	46,143,522	(4.0)
1975	44,742,515	93.4	2,908,282	6.1	260,820	0.5	47,911,617	3.8
1976	47,779,790	93.6	3,022,843	5.9	251,011	0.5	51,053,644	6.6
1977	50,466,768	93.8	3,104,678	5.7	246,891	0.5	53,818,337	5.4
1978	53,150,369	93.8	3,246,427	5.7	263,298	0.5	56,660,094	5.3
1979	54,729,776	93.8	3,388,444	5.8	250,858	0.4	58,369,078	3.0
1980	53,797,232	93.8	3,346,102	5.8	233,564	0.4	57,376,898	(1.7)
1981	55,356,824	94.0	3,311,278	5.6	231,816	0.4	58,899,918	2.7
1982	58,399,648	94.2	3,353,941	5.4	244,775	0.4	61,998,364	5.3

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*Automobiles, taxis, ambulances, motorcycles, hearses, light trucks.

**Trucks (dual tires with two axles; three or more axles), tandem trailers, buses.

Source: Massachusetts Turnpike Authority,

VEHICLE VOLUME COUNTS, MASSACHUSETTS TURNPIKE, 1973 - 1982

TABLE F-18

Fiscal Year	Passenger				Commercial	% of Year	Total	% Increase (Decrease)
	Commutation	% of Year	Non-Commutation	% of Year				
1965	15,730,967	69.8	4,924,993	21.8	1,860,712	8.3	22,516,681	
1966	15,994,018	69.0	5,260,947	22.7	1,905,465	8.2	23,160,430	3
1967	16,072,005	68.5	5,675,234	24.2	1,703,717	7.3	23,450,956	2
1968	15,807,340	65.7	6,189,340	25.7	2,050,505	8.5	24,047,378	1
1969	15,559,707	63.7	6,694,999	27.4	2,169,669	8.9	24,424,375	2
1970	15,279,543	62.1	7,141,836	29.0	2,190,382	8.9	24,611,761	1
1971	15,143,398	61.0	7,455,279	30.0	2,242,915	9.0	24,841,592	0.6
1972	14,317,547	55.9	8,961,012	35.0	2,326,350	9.1	25,604,909	0.8
1973	14,001,769	55.0	8,993,357	35.3	2,449,433	9.6	25,444,559	(0.6)
1974*	8,379,471	51.3	6,214,346	38.0	1,733,051	10.6	16,326,868	(36)
1975	10,865,249	50.0	8,620,403	39.6	2,268,100	10.4	21,753,752	(15)**
1976	10,862,438	47.8	9,622,845	42.4	2,236,287	9.8	22,721,570	5
1977	10,655,753	46.5	9,955,676	43.4	2,316,850	10.1	22,928,279	0.1
1978	10,536,403	45.5	10,239,571	44.2	2,390,478***	10.3	23,166,452	1
1979	10,763,627	44.0	10,904,822	44.6	2,771,144	11.3	24,439,593	5
1980	10,930,547	43.4	11,478,104	45.6	2,752,910	10.9	25,161,561	3
1981	10,198,679	41.8	11,586,793	47.5	2,625,069	10.8	24,410,541	(3)
1982	10,302,894	40.0	12,711,545	49.4	2,739,792	10.6	25,754,231	6

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*During 1973, the bridge was closed for over two months in September, October, and November due to a truck accident.

**As compared with the total for FY1973

***No non-revenue vehicles included.

Source 44 Massachusetts Port Authority

TABLE
F-19

VEHICLE VOLUME COUNTS, TOBIN MEMORIAL BRIDGE, 1965-1982

Sumner-Callahan Tunnels

Year	Passengers*				Commercial**	% of Year	Non-Revenue	% of Year	Total	% Increase (Decrease)
	Commutation	% of Year	Non-Commutation	% of Year						
1973	1,566,865	6.1	23,029,531	89.9	887,165	3.5	141,750	0.6	25,625,311	10.3
1974	1,499,455	6.1	22,267,641	90.5	698,854	2.8	143,403	0.6	24,609,353	(4.0)
1975	1,499,128	6.1	22,450,701	90.7	648,654	2.6	142,033	0.6	24,740,516	0.5
1976	1,451,344	5.6	23,556,263	91.2	667,514	2.6	144,136	0.6	25,819,257	4.4
1977	1,360,352	5.3	23,401,607	91.5	672,225	2.6	134,728	0.6	25,568,912	(1.0)
1978	1,231,806	4.6	24,393,274	92.1	696,656	2.6	136,658	0.5	26,458,394	3.5
1979	1,256,573	4.4	26,213,694	92.5	732,830	2.3	149,399	0.5	28,352,496	7.2
1980	2,012,759	7.3	24,806,569	89.7	671,763	2.4	167,799	0.6	27,658,890	(2.4)
1981	2,236,414	8.0	24,994,666	89.0	676,277	2.4	179,439	0.6	28,086,793	1.5
1982	2,118,744	7.5	25,290,895	89.4	707,509	2.5	180,518	0.6	28,297,666	0.8

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*Automobiles, taxis, ambulances, motorcycles, hearses, light trucks.

**Trucks (dual tires with two axles; three or more axles), tandem trailers, buses.

Source: Massachusetts Turnpike Authority

TABLE F-20

VEHICLE VOLUME COUNTS, SUMNER - CALLAHAN TUNNELS, 1973 - 1982

Month	Passenger		Trucks	Non-Revenue	Total
	Total	Carpools			
January	2,689,726	19,287	328,613	20,960	3,039,299
February	2,707,017	18,565	327,517	18,837	3,053,371
March	3,128,363	21,883	391,108	21,432	3,540,903
April	3,231,407	19,632	375,225	21,650	3,628,282
May	3,577,589	19,352	388,886	23,809	3,990,284
June	3,531,820	20,550	410,662	25,397	3,967,879
July	3,821,140	18,006	380,665	26,185	4,227,990
August	4,045,483	19,305	409,341	25,519	4,480,343
September	3,723,103	20,297	405,886	24,470	4,153,459
October	3,699,184	19,904	401,840	23,545	4,124,569
November	3,491,350	19,024	378,508	22,012	3,891,870
December	3,402,163	18,851	369,532	22,301	3,793,996
TOTAL	41,048,345	234,656	4,567,783	276,117	45,892,245

Source: Massachusetts Turnpike Authority

TABLE F-21

MONTHLY VEHICLE VOLUME COUNTS ON THE INITIAL TURNPIKE, 1982

Month	Passenger		Trucks	Non-Revenue	Total
	Total	Carpools			
January	4,273,492	35,783	248,027	19,203	4,540,722
February	4,253,481	33,464	243,611	17,141	4,514,233
March	4,996,711	39,810	292,887	19,461	5,309,059
April	4,801,585	35,715	272,739	18,302	5,092,626
May	5,058,636	35,214	283,994	18,742	5,361,372
June	5,071,499	37,194	298,626	20,944	5,391,069
July	4,783,276	33,631	276,124	21,235	5,080,635
August	4,965,514	34,920	291,304	24,393	5,281,211
September	4,992,756	35,686	290,031	23,235	5,306,022
October	5,219,394	36,095	292,757	23,586	5,535,737
November	5,018,406	34,953	279,369	18,558	5,316,333
December	4,964,898	36,145	284,472	19,975	5,269,345
Total	58,399,648	428,610	3,353,941	244,775	61,998,364

CHARACTERISTICS OF THE MASSACHUSETTS TURNPIKE: BOSTON EXTENSION

Capacity - 5,850 vehicles per hour in each direction (three lane section)
- 7,800 - 8,000 vehicles per hour in each direction (four lane section)

1982 Average Weekday Traffic - 71,200 vehicles per day (west of the Central Artery; two-way traffic)

1982 Peak Hour Counts - 4,400 (AM, Eastbound)
- 3,180 (PM, Westbound)

Source: M.D.P.W. and The Turnpike Authority

MONTHLY VEHICLE VOLUME COUNTS, CHARACTERISTICS
BOSTON EXTENSION, 1982

TABLE
F-22

Month	Passenger		Trucks	Non-Revenue	Total
	Commutation	Non-Commutation			
January	773,222	816,777	186,425	14,368	1,790,792
February	756,937	857,086	184,521	13,299	1,811,843
March	876,913	1,008,836	215,597	15,778	2,117,124
April	813,273	1,012,574	205,413	14,804	2,046,064
May	896,463	1,099,857	212,733	15,331	2,224,384
June	896,453	1,092,258	218,977	15,315	2,223,003
July	857,320	1,215,903	218,127	14,678	2,306,028
August	888,324	1,254,929	231,169	14,733	2,389,155
September	882,305	1,113,991	221,977	14,239	2,232,512
October	905,938	1,135,165	226,386	15,435	2,282,924
November	875,228	1,048,161	218,002	16,026	2,157,417
December	880,518	1,056,008	220,962	15,497	2,172,985
TOTAL	10,302,894	12,711,545	2,560,289	179,503	25,754,231

CHARACTERISTICS OF THE TOBIN MEMORIAL BRIDGE

Capacity - 4,700 vehicles per hour in each direction

1982 Average Weekday Traffic - 72,500 vehicles per day (two-way volume)

1982 Peak Hour Counts - 3,060 (AM, Southbound)
- 3,120 (PM, Northbound)

Source:
Massachusetts Port Authority

MONTHLY VEHICLE VOLUME COUNTS, CHARACTERISTICS
TOBIN MEMORIAL BRIDGE, 1982

TABLE
F-23

Month	Passenger			Trucks	Non-Revenue	Total
	Commutation	Carpools	Non-Commutation			
January	174,247	1,837	1,916,451	54,952	14,923	2,162,410
February	167,633	1,691	1,849,248	55,207	14,134	2,087,913
March	194,754	2,004	2,188,312	64,513	16,064	2,465,647
April	177,425	1,883	2,098,400	56,710	14,807	2,349,225
May	186,098	2,144	2,218,307	60,323	15,362	2,482,234
June	176,573	2,326	2,617,163	60,776	15,384	2,422,222
July	162,700	1,952	2,180,181	56,087	13,437	2,414,357
August	166,995	2,146	2,226,322	58,193	13,379	2,467,035
September	176,322	2,166	2,092,892	59,034	15,749	2,346,163
October	181,400	2,065	2,185,150	61,563	16,054	2,446,232
November	176,998	2,045	2,052,160	59,119	15,396	2,305,718
December	177,599	1,934	2,092,036	61,112	15,829	2,348,510
TOTAL	2,118,744	24,193	25,266,622	707,589	180,518	28,297,666

CHARACTERISTICS OF THE SUMNER-CALLAHAN TUNNELS

Capacity - 3,100 vehicles per hour in each direction

1982 Average Weekday Traffic - 82,800 vehicles per day (two-way volume)

1982 Peak Hour Counts - 3,160 (AM, Southbound/Sumner)
- 2,850 (PM, Northbound/Callahan)

Source:

C.T.P.S., Massachusetts Turnpike Authority, M.D.P.W.

MONTHLY VEHICLE VOLUME COUNTS, CHARACTERISTICS
SUMNER - CALLAHAN TUNNELS, 1982

TABLE
F-24

Appendix F-11

Memo on Energy Efficiency Changes from the Manager of Energy Conservation of the MBTA

To: R. L. Duvall
Chief Engineer

MASSACHUSETTS
BAY
TRANSPORTATION
AUTHORITY

From: R. F. Muehlberger

Date: August 22, 1983

SUBJECT: Energy Statistics 1978-1982

Attached is a set of graphs (6) prepared to illustrate trends in energy use, energy cost, energy use efficiency and energy prices between 1978 and 1982.

Energy Use

The first graph shows an overall 23% decline in gross energy use during the last two years. Gross energy includes the total fossil energy required at the source to produce the electric energy supplied to the system. The major contributor to this large decline was the conversion from self-generated power to purchased power; however, declines also occurred in the heating and automotive fuels.

This chart also depicts a modest decline in net energy output to the operating system. Net energy represents energy at the point of supply. Net electric energy declined by 10%, while heating fuels and automotive fuels each declined by approximately 14%.

Efficiency of Energy Use

The second graph shows the overall 20% decline in total system gross energy consumed per vehicle mile operated.

The third graph shows the variation in net energy consumed per vehicle mile which declined slightly in 1980 and 1982 but increased to a high level in 1981 (due to a 10% decline in mileage in 1981 coupled with base energy loads which are independent of vehicle mileage).

Energy Cost

The fourth graph shows the rapid increase in energy costs between 1978 and 1980 and the declines in 1981 and 1982. The six million dollar or 17% cost decline in 1982 is attributed to the electric power cost reductions realized from conversion to purchased power and reductions in power prices.

The fifth graph shows the sharp rise in energy cost per vehicle mile between 1978 and 1981 and the 19% decline in 1982 due to declines in energy use and prices.

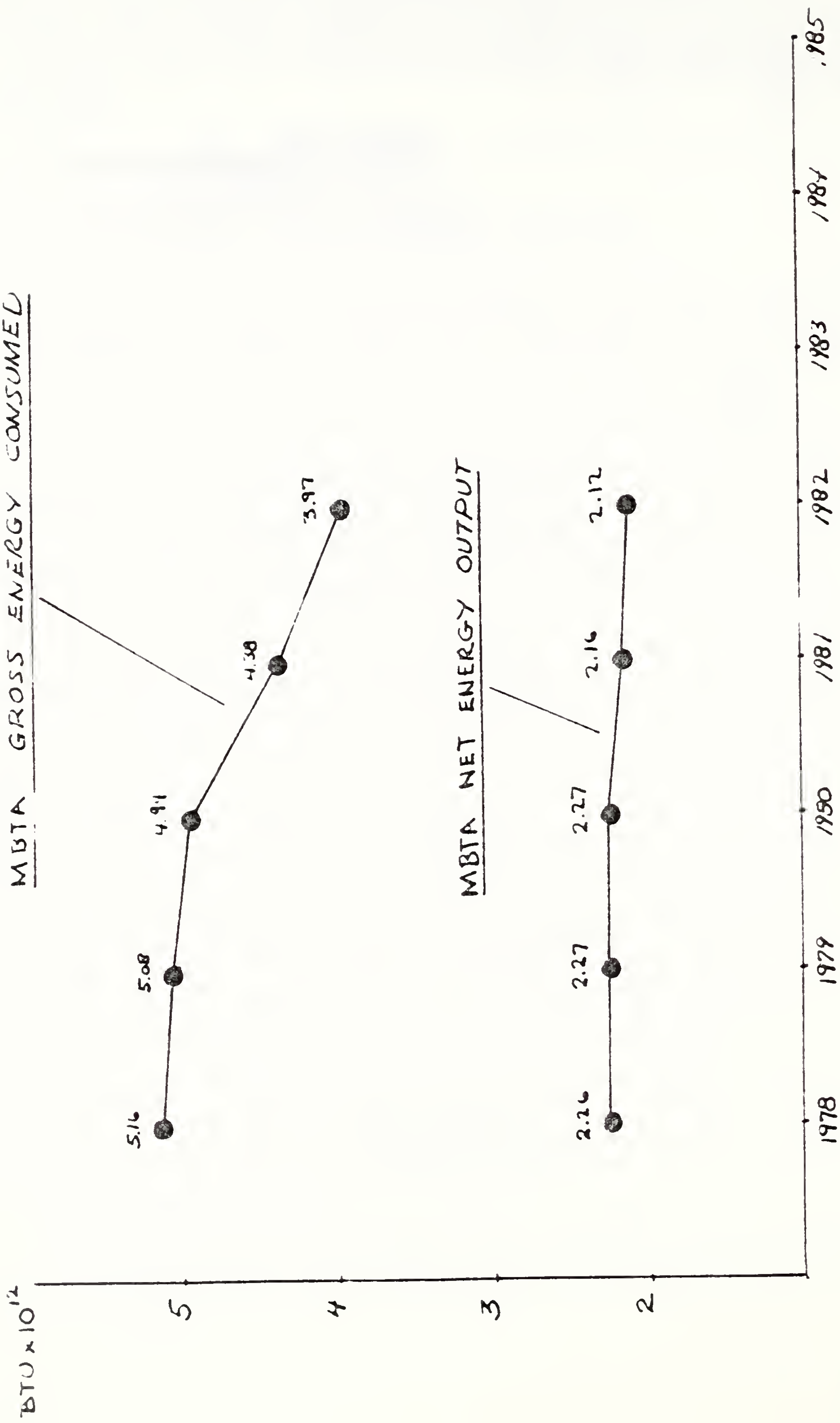
The last graph compares the cost per million BTU for the total system with the cost per million BTU of electric power, automotive fuels and heating fuels. This illustrates the dramatic impact of the conversion to purchased power on the unit cost for electric power which declined by 29% in 1982.

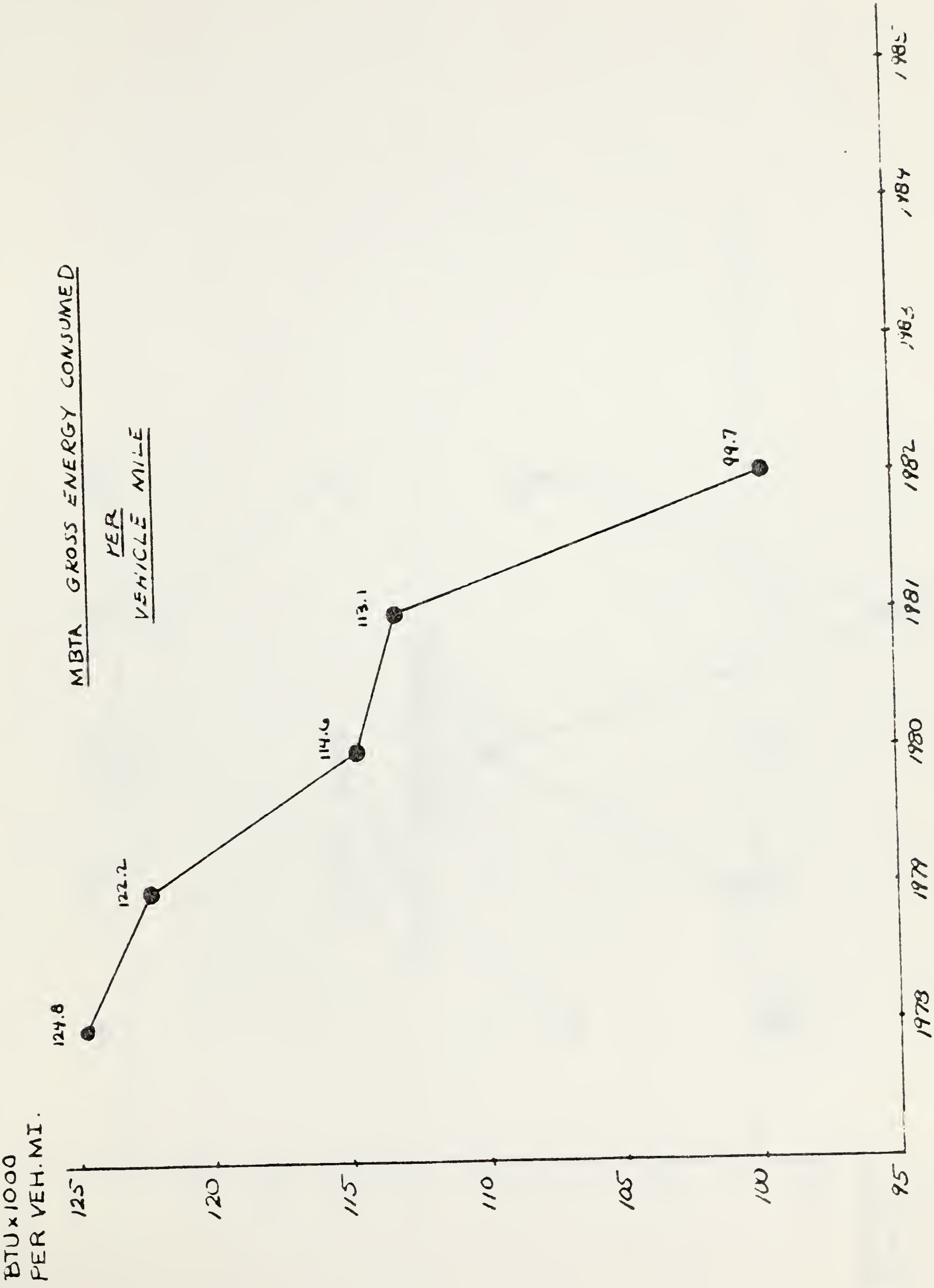
R. F. Muehlberger
Manager of Energy Conservation

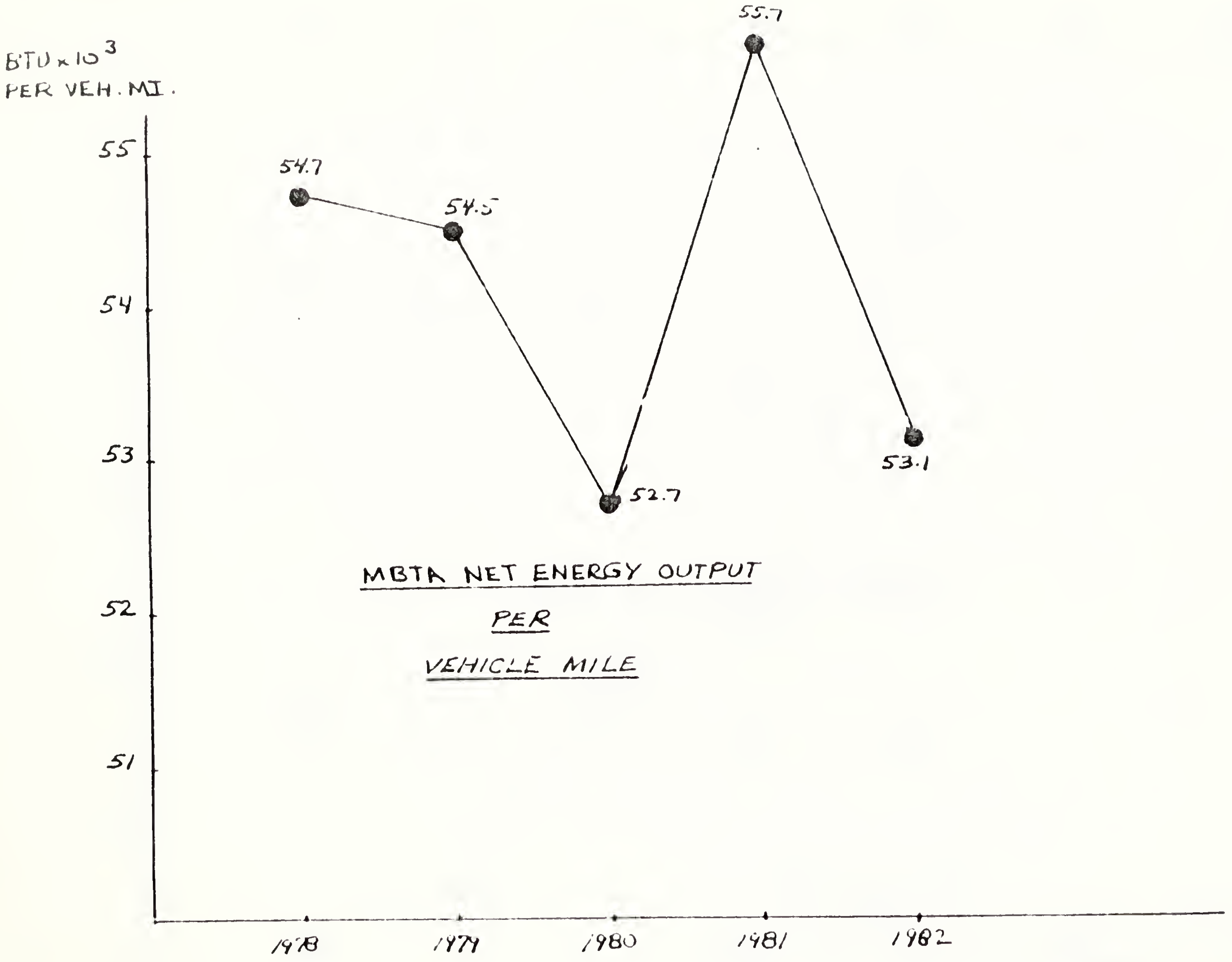
RFM/drm

Attachments

cc: E. J. Rowe
O. R. Kelly
R. M. Brown


MBTA GROSS ENERGY CONSUMED
MBTA NET ENERGY OUTPUT
BTU x 10^12
5
4
3
2
1978
1979
1980
1981
1982
1983
1984
1985
5.16
5.08
4.91
4.38
3.97
2.26
2.27
2.27
2.16
2.12

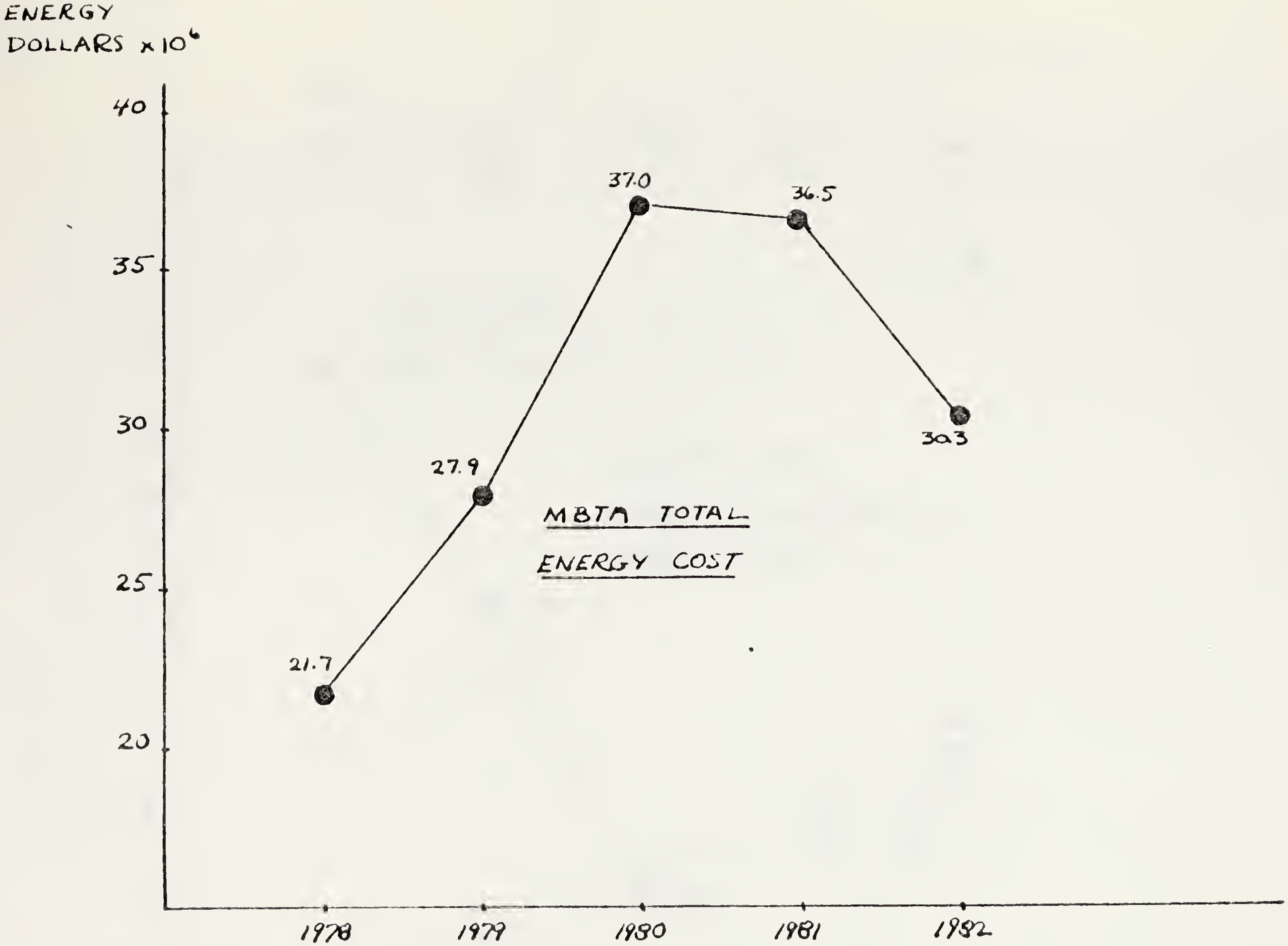

MBTA GROSS ENERGY CONSUMED
PER
VEHICLE MILE
BTU x 1000
PER VEH. MI.
125
120
115
110
105
100
95
1978
1979
1980
1981
1982
1983
1984
1985
124.8
122.2
114.6
113.1
99.7

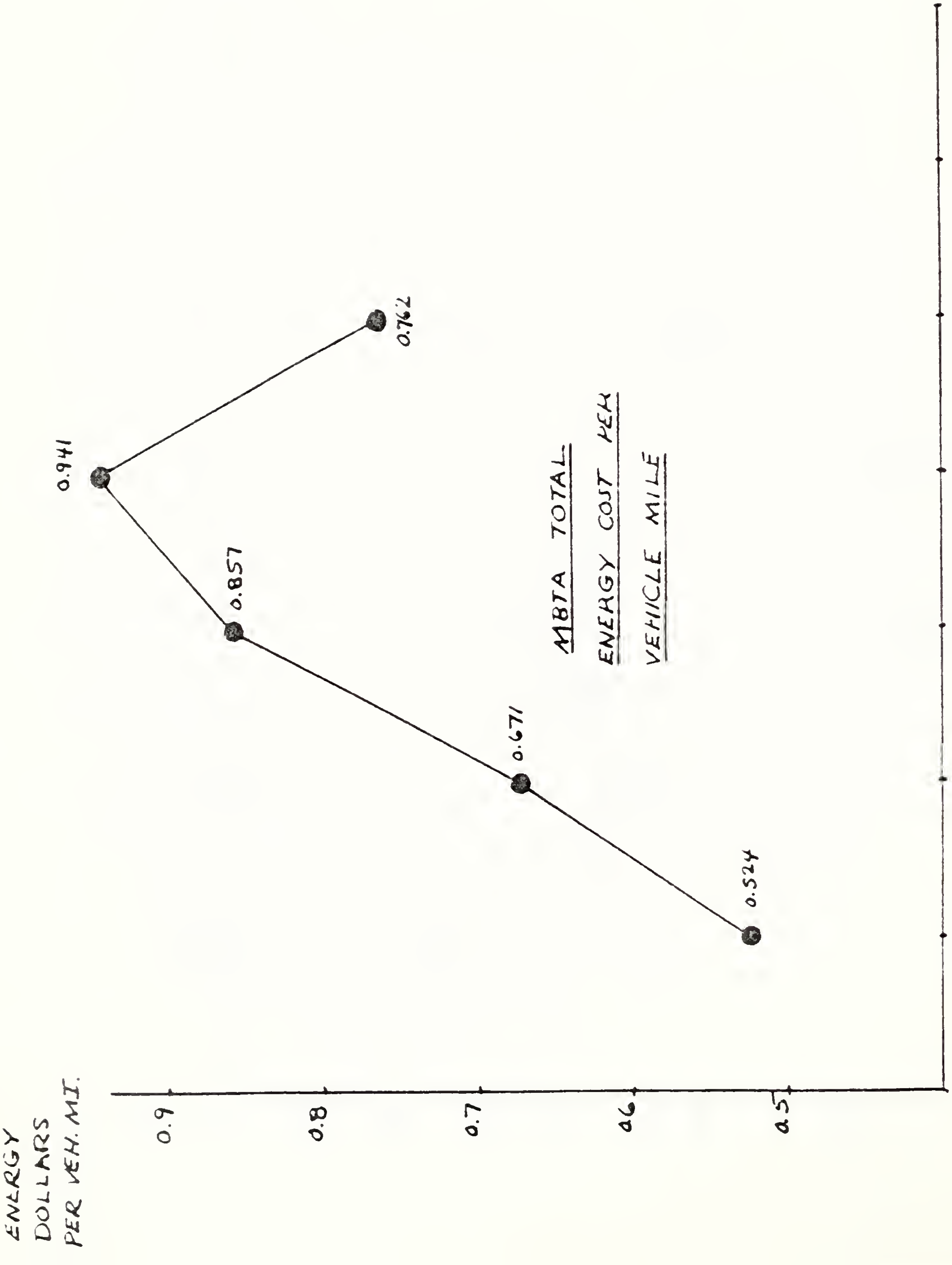


MBTA NET ENERGY OUTPUT

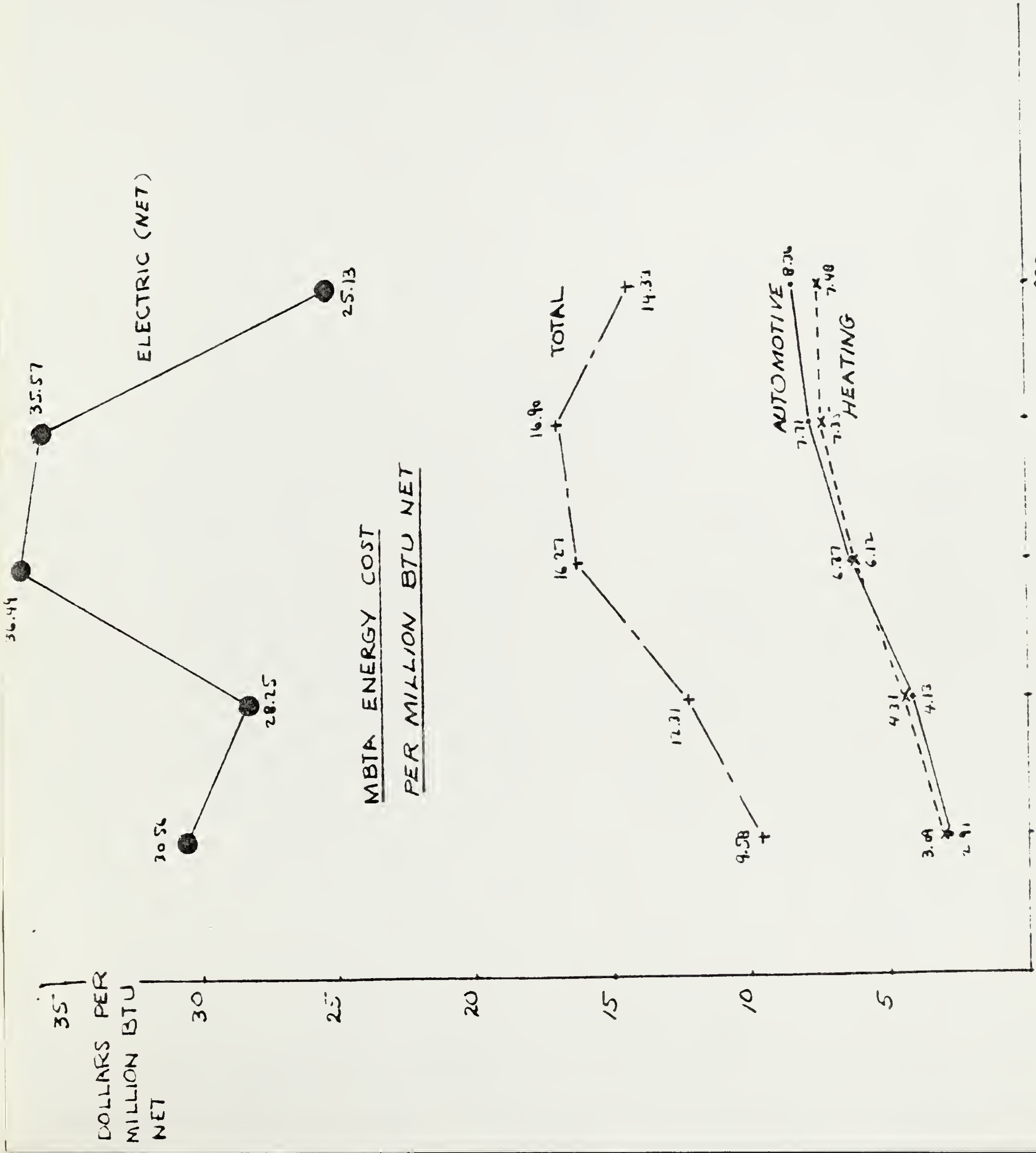
PER

VEHICLE MILE


ENERGY
DOLLARS x 10⁶
40
35
30
25
20
21.7
27.9
37.0
36.5
30.3
MBTA TOTAL
ENERGY COST
1978
1979
1980
1981
1982



MBTA TOTAL ENERGY COST PER VEHICLE MILE


MBTA ENERGY COST PER MILLION BTU NET

APPENDIX G

Service Reduction Options

APPENDIX G

SERVICE REDUCTION OPTIONS NEEDED TO REMAIN WITHIN THE $344 MILLION ADVISORY BOARD BUDGET

As can be seen from the Supplemental Budget Request, TAB A, the "Running Rate" of the Authority is approximately $15 million higher than the 1982 Advisory Board approved level of $344 million. The Advisory Board has basically calculated their savings in the Labor category, reducing the Transportation Department's budget alone by $9 million in direct wages (approximately $11 million when fringe is calculated) below its 1981 Running Rate. The Automotive Department's Labor budget was reduced by approximately $2.6 million, including fringes. The next largest discrepancy between the Advisory Board and the Authority's Running Rate is in the area of Unfunded Debt and Fixed Charges, where the Advisory Board has used optimistic interest rates to calculate a savings of approximately $3.2 million.

If the Authority is to remain within the Advisory Board's approved budget, the following types of service cuts of the magnitude described will be required:

	Savings
1. Effective April 1, 1982, per the attached list, reduce, combine or discontinue bus routes; thus, saving 81 Operators.	$2,080,000
2. Effective April 1, 1982, replace all PCC cars except on the Mattapan High Speed Line with LRV cars. Savings less mothballing - cost of approximately 70 employees, materials and services.	2,635,000
3. Reduce Commuter Rail by layoffs of maintenance personnel, shutdown of service or other combinations as presented in a separate impact statement of alternatives to be madeto the Board of Directors by the Director of Railroad Operations.	1,700,000
4. Effective April 1, 1982, curtail rapid transit service after 7:00 PM on the following lines and at the following stations:	
- Wonderland to Orient Heights - bus after 7:00 PM	170,000
- Orange Line - turn trains at Wellington after 7:00 PM	121,600
- Close the following stations after 7:00 PM and all day Sunday:	

Shawmut
Savin Hill
Kendall
Central North

Harvard/Holyoke
Green Street
Dover
Essex North and South
Haymarket Orange
Wood Island
Lechmere (Pay on Car)
Boylston
Prudential

		Savings
	(22 collectors)	$ 530,000
	- Cease all LRV Operations on Huntington after 7:00 PM	50,000
5.	Effective April 1, 1982, cut the use of the jet turbine backup by one-half, saving fuel.	300,000
6.	Effective April 1, 1982, cut local service subsidies to Salem, Peabody and Winthrop.	400,000
7.	Effective April 1, 1982, reduce planned hiring to maintain nine percent covers in Transportation; this will impact the number of dropped trips.	300,000
8.	Attempt to contract more services now performed in our Rail and Automotive Shops, and cut fuel, utilities and materials use based on reduced service.	3,655,000
9	In a combination of the spring and summer timetables, reduce 19 Automotive Mechanics based on an approximately seven percent reduced service schedule, 39 Mechanics based on use of part-time individuals for bus refueling and 60 individuals involved in bus cleaning, which may be contracted. Net savings after part-time costs and contracts are calculated.	847,000
10.	Reduce the Transportation budget in the spring, summer and fall tables by implementing service contracts for station and building cleaning, adding 140 part-time Operators, reducing the number of Starters, Gatemen and Porters. Net savings after service contract costs.	2,855,000
11.	Eliminate fifteen Car Cleaners on the Green Line and implement cleaning contracts in the summer timetable. Net savings of contract costs.	93,000
12.	In addition to the above, the Authority	

would have to generate, effective April 1, 1982, through Chapter 581 savings or a three percent cutback in Rail Equipment, Green Line, Automotive and Engineering and Maintenance, a savings equal to 60 individuals with fringe.	$2,000,000

The above savings total approximately $17.7 million. The difference between the approximately $15 million shortfall and the savings projects would be required for unemployment, Rail Equipment and Engineering and Maintenance scheduled work not budgeted for in 1981 Running Rates but critical to 1982.

APPENDIX H

Population and Employment Changes

APPENDIX H

POPULATION AND EMPLOYMENT TRENDS BY SUBREGION

This appendix contains a comparison of subregional population and employment conditions and a forecast of future conditions. The source of this information as well as the following is: Employment Location in Greater Boston: 1970-2010, Metropolitan Area Planning Council, May 1982.

Comment on Population and Employment Forecast Relationships

Because of the additional women expected to enter the region's labor force during the next thirty years, employment in all subregions is forecast to increase. Population growth is projected for only four of the six subregions. Should the subregional pattern of these employment and population changes actually occur, there would be important implications for the journey to work. Commuter travel into the urban core (Inner 128) may increase, especially from the farther portions of the Northwest and Southwest subregions. In the North Shore, South Shore, and West subregions, forecasted employment increases will just about match population increases. There will be decreases in commuter movements from the inner 128 area into the downtown area with the exception of several western communities (Cambridge, Newton, Watertown, etc.). Generally, there will be greatly increased demand for intra-regional commuter travel.

Subregional Relationship of Population and Employment Changes: 1970-1980

EMPLOYMENT*	1970	1980	Change	Percent
Inner 128	688,195	830,991	142,796	21
North Shore	123,065	151,480	28,415	23
Northwest	24,382	48,188	23,806	98
West	71,561	108,565	37,004	52
Southwest	52,360	85,623	33,263	64
South Shore	42,107	67,020	24,913	59
POPULATION				
Inner 128	1,729,726	1,574,752	-154,974	-9
North Shore	466,303	449,238	-17,065	-4
Northwest	78,299	84,668	6,369	8
West	260,404	268,707	8,303	3
Southwest	230,348	239,062	8,714	4
South Shore	248,832	268,285	19,453	8

*Nongovernment only. Expansion in coverage during the decade makes growth overstated.

Source: Massachusetts Division of Employment Security and Metropolitan Area Planning Council, Appendix E, no. 3

Subregional Relationship of MAPC's Population and Employment Forecast: 1980-2010

	1980	2010	Change	Percent
EMPLOYMENT				
Inner 128	969,631	1,050,400	80,769	8
North Shore	175,938	188,500	12,562	7
Northwest	57,716	66,400	8,684	15
West	123,095	141,800	18,705	15
Southwest	101,371	119,000	17,629	17
South Shore	78,620	90,400	11,780	15
POPULATION				
Inner 128	1,574,752	1,485,100	-89,652	-6
North Shore	449,238	445,600	- 3,638	-1
Northwest	84,668	102,100	17,432	21
West	268,707	290,900	22,193	8
Southwest	239,062	275,200	36,138	15
South Shore	268,285	285,800	17,515	7

Source: Massachusetts Division of Employment Security and Metropolitan Area Planning Council, Appendix E, No. 3

Subregional Projected Population and Employement (1980-2010)

Table H-2

Appendix I

Glossary

APPENDIX I - GLOSSARY

Captive Rider.--A traveler limited by circumstances to one mode of transportation. In some case, this includes a traveler who must use a private automobile.

In relation to transit, the term is used to identify a traveler who does not have an automobile available for a trip and must use public transit.

Cash Gates.--These are gates in rapid transit stations which have a farebox but no turnstile. They are used regularly at 10 locations in the MBTA system and may be open at other stations due to broken turnstiles or passemters. The flow of passengers through the gates is monitored by a gateman stationed at the gate.

Cold Start.--A pollution concern; high pollution rates occur when a motor vehicle is started after being off for at least four hours (one hour for a catalyst-equipped vehicles).

Collectors Turnstiles.--These are the turnstiles with a farebox located adjacent to the collectors booth and are controlled by the collector. Only elderly, handicapped or other authorized free riders and students are permitted to use these turnstiles; the recent sampling program has snown both full fare adults and adult passholders using them also.

Combination(Surface and Rapid Transit)Trip.--This is a trip made using both a surface vehicle and a rapid transit line. In each case, a transfer between the two types is made.

Congestion.--Loosely, crowdedness viewed as undesirable. Strictly, a facility may be said to be congested (seriously or significantly) when the time taken to traverse (or be processed by) the facility becomes (seriously or significantly) dependent on the demands on the facility.

Constant Dollars.--A series is said to be expressed in "constant dollars" when the effect of change in the purchasing power of the dollar has been removed. Usually the data are expressed in terms of dollars of some selected year or the average of some set of years.

Consumer Price Index (CPI).--An index issued by the U. S. Department of Labor, Bureau of Labor Statistics. The CPI is designed to measure changes in the prices of goods and services bought by wage earners and clerical workers in urban areas. It represents the cost of a typical consumption bundle at current prices as a ratio to its cost at a base year price.

Crush Capacity.--The capacity of a vehicle, including standing passengers, at which no other passengers can enter. Presumably, the maximum capacity.

Current Dollars.--Dollars current at the time designated or at the time the transaction listed took place. In most contexts, the same meaning would be conveyed by the simple term "dollars."

Demand-Responsive.--In transportation planning, demand-responsive services normally meet the needs of single passengers or small groups of passengers in response to their specific requests for service at a specific time and location.

Elasticity Analysis.--A fare elasticity is the percentage change in ridership in response to a percentage change in fare. For example, elasticities were applied to base 1981 ridership levels to predict the effects of the fare increase of August 1981. The relationship of the predicted post-fare increase ridership level to the base, pre-fare increase ridership level was used to derive a new base ridership level after a more accurate determination of post-fare increase levels was made.

Environmental Impact Statement.--A document required by the National Environmental Policy Act. All federal agencies must prepare such a statement of the significant environmental effects of all major proposals.

Inelastic.--Having an elasticity of less than one. If demand for a product is inelastic, one will spend more money on it as its price goes up. In the extreme case of inelasticity--called perfect inelasticity or zero elasticity--one would buy the same amount of a product regardless of its price.

Linked Rapid Transit Only Trip.--This includes those trips made using only a rapid transit line.

Linked Surface Only Trip.--This includes those trips made using only surface vehicles. It includes trips which are made using two or more surface vehicles. These each count as one linked trip.

Off-Peak.--This term is variously understood. In some cases, it refers to any period of travel outside the peak period. In other cases, it refers to any period or travel outside the peak-hour but excluding the base period. In yet other cases, it is the opposite of peak; that is, it refers to that period in which the least travel occurs on a system.

Operating Costs.--To be distinguished from capital cost. Those recurring costs in a transportation system, such as salaries and wages, maintenance, energy, taxes, insurance, and supplies.

Passenger Mile.--Or passenger kilometer. The measure of the transportation of one passenger, one mile (or kilometer).

Peak Hour.--The hour during which the maximum traffic occurs.

Revenue Passenger.--A passenger who pays a fare. This might seem obvious, but in some areas the number of non-fare-paying passengers can be significant: public employees who use passes, transportation system employees who ride to and from work (at rush hour) without paying fares, and so on.

Trip.--A one-direction movement which begins at the origin at the start time, ends at the destination at the arrival time, and is conducted for a specific purpose.

Trolley Bus.--Sometimes called electric bus or trolley coach. A bus powered from overhead electric lines. Since it does not run on a track, it can maneuver in mixed traffic much like an ordinary bus.

Unlinked Rapid Transit Trips.--These are any trips made on a rapid transit line, including the underground portion of the Green Line.

Unlinked Surface Trips.--These trips include any trip made on a bus, trackless trolley, or the surface portion of the Green Line.

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